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REPORT

ON THE

GEOLOGY

OF THE

STATE OF CONNECTICUT.

BY JAMES G. PERCIVAL.

PUBLISHED UNDER THE DIRECTION OF THE COMMISSIONERS APPOINTED BY THE LEGISLATURE.

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PREFACE.

THE Geological and Mineralogical Survey of the State was first suggested by Gov. EDWARDS in his Annual Message of 1835. The Legislature, in accordance with his recommendation, made an appropriation, in the session of that year, for that object. I was invited by Gov. EDWARDS to engage in the geological department of that survey, in connexion with Prof. C. U. SHEPARD, in the mineralogical department. During the summer of that year, I travelled, with Prof. SHEPARD, through every town in the State, but the short period then allowed me, only enabled me to make a general preparatory reconnoissance. An additional appropriation for the continuance of the survey, was made by the Legislature, in the session of 1836. I then commenced, by myself, a regular plan of survey, by sections across the State, from East to West, at average intervals of four miles. This I accomplished in nearly eight months constant travel. In the session of 1837, a further appropriation was made to enable me to complete the survey, after having prepared a report of my previous

explorations. This report I completed and submitted, Jan. 1st, 1838. Before commencing a re-survey of the State, I undertook an exploration of the Trap dikes traversing the Primary, which I traced throughout their whole extent. Before engaging in the survey (in 1834,) I had particularly explored the different ranges of Trap connected with the two Secondary formations in the State, and had traced them out so fully, that only two or three unimportant localities have since occurred to me. After I had completed my examination of the Trap dikes in the Primary, I commenced a re-survey of the State, by sections from East to West, as before, in the intervals between my former sections, thus reducing the average distance of my sections to two miles, and bringing myself in contact with each of the 4600 square miles in the State. This does not include my general reconnoissance the first season, nor my particular exploration of the Trap connected both with the Secondary and Primary. In my first regular survey, I had ascertained the general system of arrangement in the rocks of the State, and had prepared myself for a more discriminating investigation of the different formations. The second survey I consequently made more minutely, and devoted to it a much greater length of time. In these two surveys I had taken ample notes, in which I had marked the character and relative arrangement of the rocks in the different localities examined, as well as the direction and dip of the strata in each. I had also collected illustrative specimens in most of the localities, all of which are so arranged and labelled, that the precise locality and relation of each can, by reference to my notes, be at once determined. The number of localities from which I have collected specimens, I

have estimated at nearly 8000; the records of dips and bearings are still more numerous. I had contemplated, after the completion of my general plan of survey, a particular investigation of the organic remains accompanying the Secondary formations, as well as a re-examination of the principal mines and quarries, in order to determine their precise relations to the geological system, which I believed I had ascertained. But I regret to say, that since the completion of my general plan, I have not had the means allowed me for such additional investigations, nor even for a proper use of my materials, either notes or specimens. The report which follows is but a hasty outline, written mainly from recollection, with only occasional reference to my materials, and under circumstances little calculated for cool consideration. It was written, however, with an intention to state nothing of the truth or probability of which I did not feel satisfied. None can regret more than I do, its imperfection; still I cannot but hope that it will contribute something towards the solution of a problem of the highest practical as well as scientific importance, the exact determination of the geological system of the State.

I cannot here avoid expressing my obligations to Gov. Edwards, for the interest he has always taken in this survey. He was the first to direct public attention to it, and it was during his administration and through his influence that all the means allowed me for the completion of my survey and report, were appropriated. I take this opportunity, too, to express my acknowledgments to many other individuals, who have rendered me services during the course of my connexion with this survey. They will excuse me from a more particu-

lar enumeration. I should do injustice to my own feelings, if I did not here notice the uniform and attentive hospitality of the people of the State, during my explorations. I can truly say with a distinguished individual, lately employed in the survey of an adjoining State, that this intercourse with my fellow-citizens has greatly exalted my opinion of their kindness, intelligence, and happy condition, and much increased my attachment to my native State. I only regret that I have not been enabled to give them in return fuller and more ample results; but such as it is, I submit to them my report, conscious that I have done the best that circumstances allowed me.

J. G. PERCIVAL.

RESOLUTION FOR THE PUBLICATION OF THIS REPORT.

AT a General Assembly of the State of Connecticut, holden at New Haven, in said State, on the first Wednesday of May, in the year of our Lord one thousand eight hundred and forty-two:

Resolved by this Assembly, That not less than one thousand copies of Dr. JAMES G. PERCIVAL'S Report on the Geology of Connecticut be published under the superintendence of the author, and that a sum not exceeding fifteen hundred dollars be appropriated to defray the expenses of printing and superintending, and that the Controller of public accounts is hereby authorized to draw an order on the Treasurer for such sum not exceeding fifteen hundred dollars, to be paid out of money not otherwise appropriated:—And his Excellency the Governor and Hon. HENRY W. EDWARDS are hereby appointed Commissioners to see the object of this resolution effected.

And be it further resolved, That the Commissioners before named, be authorized to cause the copy-right of said report to be secured to the State, and to permit any additional number of copies to be published and disposed of in such manner and on such terms, as they may deem proper, for the benefit of the author. *Provided*, that no additional expense be thereby incurred by the State, over and above the sum of fifteen hundred dollars aforesaid.

REPORT

ON THE

GEOLOGY OF THE STATE OF CONNECTICUT.

In preparing a Report on the Geology of the State, the following subjects may be considered, viz. 1. The *Rocks*, or *Consolidated Formations;* the basis on which rests the entire geological system of the State. 2. The *Loose* or *Unconsolidated Materials*, accumulated on the surface, (Diluvium and Alluvium,) most of which are composed of fragments, that can be readily traced to the rocks of the State, or the contiguous rocks of the adjoining States, and can therefore be understood only by a knowledge of the rocks from which they are derived. 3. The *Soils*, which derive their character partly from the local Rock formations, where they are formed chiefly by the decomposition of the latter, and partly from the transported materials (Diluvium and Alluvium,) where these predominate. 4. The *Economical Results*, so far as regards the *useful materials* found in the Rocks, or unconsolidated formations. 5. The *Physical Geography*, which, in the following particulars, is based on the Geology of the country, viz. 1st, *Form of the Surface*, embracing all its elevations and depressions, mountains, hills, plains, valleys, &c.: 2d, *Drainage*, or *arrangement of the Water Courses*, intimately connected with the Geological form of the surface: 3d, *Routes of Communication by roads and canals*, in like manner connected

with the Geological arrangement: 4th, *Scenery*, which derives its character from the same source, each local formation presenting some peculiar traits in this respect. These different subjects will now be examined in their order.

I. Rocks.

The Rocks of this State may be referred to three classes, viz. *Primary*, *Secondary*, and *Trap Rocks*.

The *Primary Rocks* occupy much the greater portion of the surface of the State, and are divided into *two great sections* (Western and Eastern,) by the larger Secondary formation, crossing the State, from the Sound at New Haven Harbour, into Massachusetts. These Primary Rocks are formed entirely of original materials, exhibiting, as far as I have observed, no appearance of any fragment or remain of any anterior formation, and should, therefore, in my opinion, be first considered.

The *Secondary Rocks* consist of two *formations* or *basins* of *Red Sandstone* and *Shale*, closely resembling each other in character, as well as arrangement, although entirely separated by a wide interposition of the Western Primary. They are both traversed by dikes and ridges of Trap, arranged according to a peculiar system, conformably with which the Secondary Rocks are themselves arranged; the Trap having had apparently a controlling influence in determining their arrangement. These Secondary Rocks are obviously composed of fragments of the Primary Rocks adjoining, as obviously so indeed as the Diluvium accumulated on the surface of the latter.

The *Trap Rocks* are chiefly connected with the Secondary Rocks, where they present a series of *dikes* and *ridges*, (the last a modification of the dike,) arranged, as just observed, according to a peculiar system, to be afterwards detailed. Besides these, there are four extensive Trap dikes, traversing the Primary Rocks, two in the Western and two in the Eastern Primary; one of the latter entirely crossing the State, from the Sound into Massachusetts. These dikes are apparently

appendages of the Trap System, connected with the larger Secondary formation, as will be afterwards explained. The Trap Rocks, both connected with the Secondary and the Primary, have obviously the character of *intrusive* rocks, of igneous origin.

Having presented this general outline, I will now proceed to a more detailed view of the

Primary Rocks.

The Primary Rocks, as already stated, are divided into two great sections, by the interposition of the larger Secondary formation, viz. the *Western*, embracing all that portion of the State west of that formation, excepting the smaller Secondary formation, included in it, nearly in its centre; and the *Eastern*, embracing all that portion of the State, east of the larger Secondary formation. These two sections include each a series of *subordinate local formations*, arranged according to a peculiar system in each. These two systems present indeed several striking analogies, and apparently conform to one great system of arrangement, doubtless common to the whole of the great Primary formation, extending along the Eastern side of North America, from Georgia northwards; yet I have not been able to trace any one of the local formations of one section directly into either of those of the other section. It is true, there are formations in the two different sections, which present some striking resemblances to each other; but they are entirely detached, not merely by the interposition of the Secondary, but by that of other Primary formations. In no instance have I observed a formation, terminating on one side of the greater Secondary basin, which could be distinctly traced on the opposite side. This subject will be farther considered, after having completed the detail of the subordinate Primary formations.

The two Sections (Western and Eastern) are only partly included within the limits of this State. The Western extends, on the West and South-West, into the Southern part of New

York State, and on the North, into Massachusetts. The Eastern extends, on the North, into Massachusetts, and on the East, into Rhode Island. The exact determination of the Primary Geology of this State would therefore furnish a *clue* to the Primary Geology of Southern New York, as well as of Massachusetts and Rhode Island, and not only of those States, but of the whole Atlantic Primary of North America. From the great extension of which the subject is thus capable, as well as from its peculiar intrinsic importance to *my own State*, and also from the great difficulty of the investigation, I have considered the determination of the Primary Geology of the State, as much the most important part of the survey.

In pursuing this inquiry, I was early satisfied that my only chance for determining the system of arrangement, was to confine myself solely to the objects under investigation, and to endeavor to trace my way through, by the most careful examination and comparison of them, uninfluenced by exterior authority. In this pursuit I have expended a large amount of time, and made the most strenuous and unwearied efforts, though much of the time under circumstances extremely unfavorable and discouraging. I had not gone far in my inquiry, before I perceived clearly that something more distinct and definite than the old arrangement of Granite, Gneiss, and Mica Slate, was necessary, to enable me to solve the problem I was investigating; and as I proceeded farther, I became satisfied that it would be as hopeless to attempt to arrive at the true arrangement of the Primary Rocks, by those distinctions merely, as it would be to determine the arrangement of the Secondary Rocks, by merely observing the distinctions of Sandstone, Limestone, and Slate. I soon perceived, as I proceeded in my exploration, that the Primary Rocks were arranged into *local formations*, in each of which the rocks had a peculiar *distinctive* or *specific character*. My great object has since been to trace out these formations in the most exact manner possible, and to determine with precision their peculiar character, as well as their extent, relations, and arrangement.

By carefully observing their minute characters, I conceive that the Primary Rocks may be arranged nearly as definitely as Mineral Species. The characters of the Primary Rocks may be founded on the *Mineral Species*, which enter into their composition—on their *structure*, or the peculiar mode in which the individuals of those species are arranged, or in other words, the law of their combined crystallization, and on the peculiar *physical character* of the mineral species, as respects form, colour, lustre, grain, &c. from which is derived a *physical character*, peculiar to each rock. Individual rocks may thus be characterized by their composition, as Felspathic, Quartzose, Micaceous, Hornblendic, &c.; or by their structure, as uniform, veined, porphyritic or sub-porphyritic, &c.; or by their physical character, as coarse or fine grained, more or less regularly crystalline, with round or elongated forms, with different kinds or shades of colour, and different qualities or degrees of lustre, &c. By attentively observing all these peculiarities, each rock presents a peculiar physiognomy, by which it may be easily distinguished, even in remote fragments.

It is customary to divide Primary rocks into the two great divisions of Stratified and Unstratified. This distinction does not appear to me sustained by an examination of the Primary rocks of this State. All the Primary rocks of the State, with the exception of occasional transverse veins, generally small, and forming but a very slight portion of the whole, appear to me obviously parallel in their structure, nor can I doubt their cotemporaneous formation. I prefer the term parallel to stratified, in describing the arrangement of these rocks, as simply expressing the fact, without implying any opinion as to their mode of original formation. I defer the particular statement of facts on which I have grounded this conclusion, to another part of the Report.

In the same manner as individual rocks, local formations may be distinguished by their *mineral composition*, *structure*, and *physical character*. Generally, some one or two minerals predominate in a formation, and give it its first and most

obvious character. In this way, a formation may be Felspathic (Granitic,) Micaceous, Hornblendic, &c. But even where different formations are characterized by a predominance of the same mineral, they may differ essentially in the peculiar structure and physical character of their rocks. Thus, different Micaceous formations may be coarse or fine grained, uniform in their structure, or veined, or porphyritic, of different colour or lustre, &c. It is only by minute examination and comparison, that the full force and value of these distinctions can be perceived. But although each formation is generally characterized by the predominance of some one or two minerals, yet in no instance have I observed a formation composed of one particular rock. Generally, several rocks, differing in their composition, or by other characteristics, are found grouped or alternating in each formation. But although each of these rocks possesses its distinctive character, some common features of resemblance may be traced between all the rocks of the same formation, apparently indicating that a peculiar mode of crystalline action prevailed throughout its limits. What farther general remarks I may have to make on the Primary Rocks, will be introduced as a sequel, after a detailed account of the local formations.* In describing these, I begin with the

Western Primary System.

This System is bounded East by the larger Secondary formation, and South by the Sound. It extends on the West into New York, and on the North into Massachusetts. The more general arrangement of the System will be best explained after a detailed account of the individual formations composing it, beginning with the most Eastern.

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* The situation in which I have been placed, since completing my exploration, has rendered it impossible for me to enter on an examination of my materials, and consequently has put it out of my power to describe the different rocks and formations of the State with that exactness which a proper use of my materials would enable me to do, and has also prevented me from laying down in detail a systematic view of the physical characters of the Primary Rocks, which I had contemplated.

A. *A Chloritic Formation* (Chlorite Slate.)

This extends, in a somewhat curvilinear direction, from a point N. W. of Westville (New Haven,) on the North-East, to the Housatonic, just above Milford Point, on the South-West. It adjoins the larger Secondary formation on the East, from its Northern point to Savin Rock, on the West side of the entrance of New Haven Harbour, whence it extends along the Sound to its S. W. extremity. If continued farther S. W., in the line of its direction at Milford Point, it would cross Stratford Point, on which, however, as far as I have observed, no rock in place is visible. A ledge of Serpentine, with small points of Limestone, similar to that accompanying this Chloritic formation, occurs on the West bank of the Housatonic, below Stratford Landing, and is apparently connected with it, though in a line farther North than its supposed continuation. This formation is widest in its middle part, from Savin Rock, North-Westerly, but terminates quite narrow towards the North and South. The prevailing rock is a green Chlorite Slate, composed chiefly of Chlorite and Quartz, in variable proportions, and varying conformably in thickness and hardness. Sometimes it is very even; at other times, highly contorted, when it frequently abounds in layers and veins of Quartz. Occasionally it is very regularly grooved or fluted longitudinally. Beds or seams of a greyish Talco-Chloritic variety occur, which sometimes is highly Talcose, but too slaty to answer well for Soapstone. Along its Western border, where it passes into the adjoining Argillitic formation (B,) a greyish Talcose variety is common, apparently forming a transition into the Argillite.

This formation is traversed by two subordinate, nearly parallel ranges, quite distinctly characterized. One (1,) on the East, consists chiefly of a Chloritic Greenstone, in parallel beds, alternating with Chlorite Slate, or a Chloritic Greenstone Slate. This Greenstone occurs in thick beds, rarely fissile, breaking into rhombic prisms, of various size, sometimes very small. It is distinctly interstratified, and its structure obvi-

ously parallel, and is undoubtedly of contemporary formation with the Chlorite Slate. It is partly uniform in its structure, when it is usually fine-grained, and more Chloritic; partly porphyritic with Felspar and Hornblende, when it is coarser-grained, and lighter coloured. These varieties frequently alternate. Occasionally, though rarely, beds occur of a very dark-coloured variety, extremely fine-grained, and compact, resembling a very fine-grained Trap. This range commences on the North, just South of the Derby Turnpike, and extends first South, and then South-West, nearly to the East side of Milford Harbour. It adjoins the Secondary on the East, as far South as the Milford Turnpike, when it bends South-West, conformably to the general curve of the formation, leaving between it and the Sound, a comparatively wide range of Chlorite Slate. Subordinate beds of Chloritic Greenstone occur in other parts of the formation, particularly in its North-Western part.

The other subordinate range (2,) farther West, is characterized by a line of beds of *Serpentine Marble* (Limestone.) This range of Limestone is divided into two sections, separated by a wide interval, but in the same general line of direction; one, smaller, on the North, extending about half a mile, and including the New Haven Marble Quarries; and one, larger towards the South-West, extending 2—3 miles, and including the celebrated Milford Quarry. This Limestone (Marble) is remarkable for its finely variegated colours, particularly green and yellow, and is more or less blended with other minerals (Serpentine, Talc, Asbestos (Picrolite,) Pyroxene, Epidote, Chromic and Magnetic Iron.) The beds are interposed between the strata of the adjoining Chlorite Slate, but are more or less interrupted, like Granite beds in the direction of the rocks including them. The Limestone of the two sections is quite different in character, especially in the quality and arrangement of colours. That of the Northern Section is generally lighter coloured, and remarkable for its fine shades of yellow. That of the South-Western is darker shaded, par-

ticularly with green and blue, and occasionally presents nodules of black Serpentine, separated by small veins of lighter tints, giving it the character of a *verde antique*. In the interval between the two sections, small beds and seams of Limestone occasionally occur; and throughout the entire range, the Chlorite Slate has a peculiar character. It is frequently very tortuous and nodular, and abounds sometimes in veins and nodules, compactly fine, and of a light yellowish-green colour, (Epidote,) and also more rarely in veins of a reddish Felspar. Small beds or veins of Limestone, of a similar character, occasionally occur in other parts of this formation, both East and West of the main range, and these are accompanied with similar peculiarities, in the Chlorite Slate adjoining, particularly the yellow-green nodules. A narrow band of this kind may be traced for a considerable distance, near the Western border of this formation, towards its Northern extremity.

The Northern point of this formation is traversed obliquely, in a South-West direction, by one of the Trap Dikes in the Western Primary. The Chlorite Slate, adjoining the dike, is remarkably indurated and altered, being converted from a soft green Chlorite Slate, into a dark bluish compact flinty Slate, sometimes variegated with light yellowish veins, and with crystallized Prehnite included (SHEPARD.)

Copper (Yellow Pyrites,) in quartz veins, has been observed in different localities in this formation, particularly at Lambert's Mine, in Orange, in the interval between the Chloritic Greenstone and Limestone ranges (1—2.) Lead (Galena) with Copper (Pyrites) has been found in a vein, adjoining the Derby Turnpike, formerly worked slightly.

This formation, as already observed, presents a curvilinear outline, with its chord bearing North-Easterly. The direction of the strata corresponds with that of the formation; in the middle part, more nearly North-East; towards its Northern point, varying even to West of North, and at its South-West point, bearing nearly W. S. W. At its extreme Northern point, its strata bend suddenly to the East; the adjoining Ar-

gillite curving conformably, as if inflected round it. The dip of the strata varies also with the direction. The general direction of the dip is Westerly. In the middle portion, the dip is generally moderate, particularly towards the Eastern border; towards the two extremities, the dip is generally large, sometimes nearly vertical, and near the Northern point, occasionally shifting to the East. At the curve, at its Northern extremity, the dip is small North. In tracing the Eastern boundary of this formation, towards the Secondary, we observe the more Eastern subordinate ranges successively terminating farther towards the South, as indicated on the map; the formation at the same time receding Westerly, as it advances Northward. Thus the most Eastern range (of Chlorite Slate) terminates South of the Milford Turnpike; the Greenstone range, South of the Derby Turnpike; the Limestone range, South of Westville. Here the formation suddenly recedes West, around the South front of West Rock, and then extends North along the West side of the Valley of West River, to its termination. The question might here arise, whether these subordinate ranges were once continued farther North-Easterly, through the country now occupied by the Secondary. The consideration of this subject I defer to another part of the report. While the formation recedes on the East, towards its Northern extremity, it advances, though in a less degree, towards the West. The position of the Serpentine bed, West of the Housatonic, already referred to, would seem to indicate a similar arrangement towards its South-Western extremity. It will be observed, that the direction of the formation, in its Southern part, corresponds with the direction of the coast.

B. *An Argillitic Formation* (Argillite.)

This formation extends along the West side of the preceding, from a point North of Milford village, to its northern extremity, already indicated. Farther North, it extends along the West side of the Secondary, West of West Rock, till it terminates, about West of Mt. Carmel, running out between ridges of Trap,

connected with the Trap System of the Secondary. It adjoins on the West, throughout its whole extent, the next (Micaceous) formation (C.) It does not extend as far S. W. as the preceding formation, which, West of Milford, adjoins the Micaceous formation (C;) but on the contrary, it extends farther North; the preceding formation, terminating, in that direction, nearly opposite its middle point. The southern point of this formation I have not been able to determine precisely, from the prevalence of Diluvium, in that part of its range. This formation is quite narrow at its extremities, and widest in its middle portion, presenting in the whole an oblong elliptical figure. It also presents, though in a much less degree, a curve similar to that of the preceding formation. At a point near the Derby Turnpike, it advances West, conformably to a similar advance in the Chloritic formation, near its Northern extremity. North of this point, the curvilinear outline is most distinctly marked.

The present formation consists of a well marked Primary Argillite, which shows, very distinctly, by its physical characters and its relations, its intimate connexion with the adjoining Micaceous formation (C.) The prevalent variety is dark blue, smooth and shining, more or less thinly fissile; sometimes very even; sometimes plaited, grooved, or contorted. Generally it is quite decomposible, breaking very readily into jointed fragments, so that entire ledges are rarely found on the surface. It decomposes into a dark argillaceous loam, very capable of agricultural improvement. Occasionally alternating beds are met with, of a light grey, thicker, fine grained, dull quartzy variety, often highly pyritiferous and ferruginous, and more nearly resembling some of the quartzy varieties of Mica Slate. Quartz veins occur frequently, sometimes of a large size, particularly on the eastern side of the formation, North of the termination of the Chloritic formation (A.) Delicate seams or flakes of pure white Talc occur in these veins.

North of its middle point, and farther North than the large Quartz veins (1,) just noticed, a range of interstratified beds of

Limestone (2) crosses this formation very obliquely, in a N. Easterly direction, terminating on its eastern border, near the ascent of the Litchfield Turnpike from the valley of West River, and on the S. W. near the old Bethany road. This Limestone is of a darker or lighter bluish grey colour, and is more or less blended with the substance of the Argillite; the purer varieties are thicker and less fissile. It abounds in iron pyrites, and its surface is generally much decomposed, and very ferruginous, resembling somewhat the weathered surface of the more ferruginous Trap rocks.

Farther North, a range of smaller beds (3) also crosses this formation in a similar oblique direction, consisting of a peculiar Felspathic rock, generally fine grained, and in the smaller beds distinctly parallel and schistose, with small oblique veins or seams of Quartz; but in a larger bed, on the Eastern border of the formation, less distinctly parallel and more uniform in its structure, forming a variety of Granite, and breaking into small irregular prisms. The adjoining argillite is there highly contorted.

The Trap Dike, mentioned under the preceding formation, crosses the Southern half of this formation, obliquely, in a S. Westerly direction. The trap has produced less striking effects on the adjoining Argillite, than those noticed in the adjoining Chlorite Slate. The same remark is true of the Argillite, adjoining the Trap, connected with the Secondary, as it crosses the northern extremity of this formation.

The more even and fissile varieties of the Argillite may perhaps be used to advantage for roofing; but, as the layers are in the direction of the strata, and not formed by transverse cleavages, as in the best Slate quarries, the utility of such application is doubtful.

This formation passes into the former, on the East, by a greyish Talco-Chloritic Slate, already noticed, and into the Micaceous formation (C,) on the West, by a darker, more micaceous variety, characterized by transverse flakes of Mica, a variety which I have noticed, in other instances, at the junc-

tion of Mica Slate and Argillite. A peculiar variety of very dark Siliceous Slate, composed of Quartz, blended with minute argillitic or micaceous scales, and more or less traversed by minute Quartz veins, nearly or quite parallel, with occasional small nodules of crystalline Quartz, accompanied with minute garnets, is also found near the junction of the Argillite with the Micaceous formation (C.) The Argillite itself, as it approaches its Western border, becomes distinctly more flaky, presenting a sub-micaceous appearance.

The general direction of the strata corresponds with that of the formation, namely, N. N. E.—The dip is generally large West; sometimes nearly vertical, or slightly deflected East. Where the Argillite is inflected around the Northern point of the Chlorite Slate, the direction and dip change abruptly from N. N. E. large West, to nearly East, slight North. This formation presents throughout a more uniform character, than perhaps any other Primary formation, of equal extent, in the State.

C. *A Micaceous Formation* (Mica Slate.)

This formation extends along the West side of the two preceding, from the plain between the Housatonic and Bridgeport Harbour, N. N. Easterly, to a point adjoining the larger Secondary formation, not far North of the Northern termination of the Argillite (B.) At its Northern extremity, it adjoins a Trap ridge, connected with the Secondary Trap System, as already noticed, extending North, from the Northern termination of the Argillite, along the Eastern border of the Primary. The prevalent rock, throughout this formation, is a Mica Slate, or compound of Mica and Quartz, in which the former usually predominates. At times, however, the presence of Felspar is distinctly obvious; but even in such instances, the rock preserves its general physical character. Its accompanying minerals also indicate the peculiar class of formations to which it belongs.

Several subordinate formations are included in the main

formation. As each of these possesses its peculiar characteristics, it would be premature to attempt a general description of the whole, before presenting a more detailed view of its parts.

1. At its Southern extremity, is a large nearly circular subformation, of a light silver-grey Mica Slate, with greenish shades or patches on the surface of its layers; accompanied with large beds, or subordinate ranges, of a rather light green spicular Hornblende Slate. These beds are more abundant along its Eastern border, North-West of Milford village, where they are associated with a darker grey ferruginous Mica Slate, readily breaking in small jointed fragments, accompanied with large veins of limpid Quartz, and small beds of white Limestone. The Limestone is in part very pure white and hard, and partly sub-micaceous, ferruginous and decomposible. This sub-formation of silver-grey Mica Slate extends along both sides of the Housatonic as far North as Wooster's Cove, North of which, on the West side of the river, a small process of the same extends some distance North, accompanied with the same light green Hornblende, and this towards the North, with traces of an impure ferruginous limestone. The Mica Slate of this sub-formation is generally rather coarse-grained and uneven, but occasionally beds occur of a fine-grained, uniform, light grey Quartzose variety, usually quite even. Some of these would apparently answer well for flagging, but the small extent of the beds, and their almost vertical position in the rock, will probably render the working of them impracticable. Seams and nodules of dark green compact Chlorite occasionally occur in the rock of this sub-formation, particularly in connexion with Quartz veins. These latter are also accompanied with patches, sometimes large, of black tourmaline. Garnets are less frequent than in some other parts of the formation. West of Milford village, the interval between the present formation (C,) and the Chlorite Slate (A,) is occupied by Diluvium. Not far from the S. Western termination of the latter formation, a surface ledge is observed near it, of a light

grey Talco-Micaceous Slate, apparently indicating a passage from the Mica Slate (C) into the Chlorite Slate, similar to the passage, already noticed, from the latter into the Argillite.

A valley extends East from the Housatonic, near Wooster's Cove, along the North side of the sub-formation (1,) nearly to the valley of Milford river, separating the sub-formation (1,) from two other parallel sub-formations, on the North; one, on the East (3,) characterized by numerous beds of a light grey Micaceous Limestone, and one, on the West (4,) characterized by large beds of Granite.

East of the sub-formation (3,) is a subordinate range (2,) adjoining the Argillite (B,) on the West, extending along both sides of the valley of Milford river, from a point not far North of the Derby Turnpike, nearly to Milford village, and thus continued farther South than the sub-formations (3 and 4.) The range (2) consists chiefly of a dark blue, or dark bluish-grey, thin, rather even Mica Slate, apparently graduating on its Eastern border into Argillite, and especially near the line of junction, characterized by transverse flakes of Mica. It abounds throughout in garnets, even where it most nearly approaches Argillite. The Mica Slate of this range ascends nearly to the summit of the ridge extending S. S. W. from North Orange, the summit of which is occupied by the Argillite (B,) but in no instance, from the prevalence of Diluvium, have I observed the two rocks in actual contact. This range (2) is apparently terminated on the North, by the projection of the Argillite to the West, North of the Derby Turnpike, already noticed. West of the sub-formation (4,) a narrow band, similar to the range (2,) occurs, at least in certain points, if not throughout the whole extent of that sub-formation. Such a band extends some distance North from Wooster's Cove, along the West bank of the Housatonic, and East of that river, a similar band occurs adjoining the Derby Turnpike. The rock here contains staurotides, along with garnets.

The sub-formation (3) extends along a ridge of hills, West of the valley of Milford river, from the Eastern termination of

the cross valley, above noticed, Northward to the Derby Turnpike. Here it is apparently interrupted, but after a large interval, I observed a small bed of Limestone, similar to that of the present sub-formation, in the Mica Slate, on its Eastern border, in the road leading North from Woodbridge meeting house, and nearly West of the S. W. point of the Limestone range in the Argillite. The Mica Slate of the present range is dark grey, usually hard, and very prismatic, the exposed ledges being generally much broken in jointed fragments. It is quite similar to the Mica Slate, accompanying the green Hornblende and white Limestone, nearly in the same line, farther South, already noticed under the sub-formation (1,) but its associated minerals are very dissimilar. The Limestone of this range is of a dark or light grey, and more or less schistose, according as it is more or less blended with Mica. Like that accompanying the Argillite, it is more or less ferruginous and decomposible. The weathered surface of the harder varieties is generally rounded from partial decomposition, and very dark-coloured. Beds occur in the Mica Slate, particularly adjoining the limestone, abounding in Hornblende and Pyroxene. The Hornblende is dark-coloured and massive, and very unlike that of the sub-formation (1.)

The sub-formation (4) commences on the North side of the cross valley, above noticed, and extends North, in a rocky ridge, along the East side of the Housatonic, to the Derby and Milford road, whence it ranges North-Easterly, crossing the Derby Turnpike, till it terminates, on the Eastern border of the present formation (C,) near the Humphreysville Turnpike. This range abounds more or less in interposed beds or veins of Granite, or rather of a white Felspathic rock, distinctly parallel in its structure, and stratified as obviously as the including Micaceous rock, yet sometimes very coarse-grained. More frequently, however, it is rather fine-grained. This rock is usually very Felspathic, and its crystals are arranged so as to present a tessellated or mosaic appearance, particularly on the weathered surface. The Mica Slate of

the present range, like that of the preceding, is dark grey and fragmentary. It is frequently accompanied, particularly adjoining the Granitic beds, with Hornblende and Pyroxene, not unlike that accompanying the Limestone of (3.) In the same N. Easterly direction, as the North point of the present range (4,) after a considerable interval, a group of large beds of a similar Granite, with a more striking mosaic structure, composed chiefly of white Felspar and Quartz, occurs on the Eastern border of the formation (C,) in a line S. W. from the Felspathic beds, traversing the Argillite (B.) These beds are associated with the peculiar rocks, marking the junction of the Argillite with the present formation (C,) already noticed.

Along the Western border of the formation (C,) apparently throughout its entire length, extends a range (5) of a dark bluish grey, more or less plumbaginous Mica Slate, generally very micaceous, and wavy or contorted. Sometimes it has quite the appearance of an Argillite, but with garnets. A subordinate band traverses it, generally nearly in its middle point, consisting of a very tortuous plumbaginous variety, abounding in small quartz veins, and usually breaking into irregular conchoidal fragments. Garnets generally abound in the Mica Slate of this range, though less frequent in the central band just described. Quartz veins are also frequent. This range (5) extends first along the West side of the sub-formation (1,) and farther North, along the West side of (4,) to its Northern termination. Farther North, it occupies nearly the entire width of the formation (C,) adjoining the Argillite on the East. On the West, throughout its entire length, it adjoins the formation (D,) next described, into which it usually passes by a narrow band of a lighter grey Micaceous rock, generally silvery-shaded, and more or less Felspathic, associated with which, in its Northern part at least (N. E. of Derby,) occur beds of a light green spicular Hornblende, similar to that accompanying the sub-formation (1,) with occasional traces of Limestone. Along the Western border of the present range, sometimes are found beds of a dark grey, fine-grained, even Quartzose Mica Slate,

not unsuitable for quarrying, as at Derby Landing, on both sides of the Housatonic. Near its S. W. termination, on its Western border, occurs a decomposible ferruginous variety, abounding in Quartz veins, in which traces of Galena are observed.

The present formation (C) is comparatively wide in its Southern half, but towards its Northern point gradually becomes quite narrow; the Southern and Eastern ranges (1—2—3—4) running out, and the Western range (5) occupying its entire breadth. From this peculiar arrangement, and from the apparent continuation of the Limestone and Granite, of the ranges (3—4,) across the Argillite (2—3,) the latter would seem to be supplementary to the present formation. This view is rendered farther probable by the fact that the Argillite extends less far to the S. W. than the present formation, and that it advances to the West and expands in width, nearly opposite the point where the Southern ranges of the latter terminate. The sub-chloritic character of the sub-formation (1,) which adjoins the Chlorite Slate (A,) near the S. W. termination of the latter, is worthy of notice.

The direction of the strata, in the present formation (C,) corresponds with its general direction, viz. N. N. E.—The dip is usually very large West. In some parts of the formation, however, the dip is East, generally large. This is particularly the case in the range including the Limestone (3,) and along the eastern border of the Granitic range (4.)

The Trap Dike, noticed under the two preceding formations, enters the present formation, S. W. of North Orange, but extends, apparently, only to the Eastern border of the sub-formation (1.)

D. *A Porphyritic Formation* (Gneiss.)

I have named this formation from the predominant structure of its rocks, although rocks of a different character are included within its limits. The formations, already described, are marked by comparatively distinct and uniform outlines, although the subordinate parts, particularly in formation (C,) are

more intermingled; but in the present formation, and in those farther West, the outlines are more irregular, and the formations themselves, more or less intermingled.

The present formation (D) may be considered as extending from the S. W. corner of Fairfield, at Compo Creek, N. Easterly, in a somewhat curvilinear direction, to the S. W. corner of Southington. It extends along the Sound, from its S. W. point, to Bridgeport Harbour, and then bears N. N. Easterly, along the West border of the formation (C,) till it meets the Secondary, near the N. E. corner of Bethany, whence it extends along the West side of the Secondary, to its Northern termination. The Eastern boundary of this formation, towards (C,) is comparatively regular, though somewhat undulating. The Western outline is marked by a peculiar variety of silvery-blue Micaceous rock (Mica Slate,) characterizing the next formation (E.) This Western border is less distinctly marked than the Eastern, and comparatively irregular; still the line of junction of the two formations (D—E,) is sufficiently marked by certain peculiarities on either side, which will be best explained after a more detailed account of the present formation. This presents, in the whole, a long, comparatively narrow range, with alternate contractions and expansions. It is of moderate and nearly uniform width, in its Southern part, adjoining the Sound, quite narrow in Huntington (S. W. of Derby village,) comparatively wide in Bethany, and again becoming more and more narrow, towards its Northern extremity, where it terminates in a point. These irregularities in its outline are caused by the corresponding irregularities of its Western boundary, as will be obvious by an inspection of the map accompanying this report.

The predominant rocks of this formation are Porphyritic or sub-porphyritic in their structure; the former marked by comparatively large and detached porphyritic points of Felspar, while in the latter, the porphyritic points are smaller and more uniformly distributed. The large porphyritic varieties are not always the coarser grained, for in some instances, very large

porphyritic points are imbedded in a very fine-grained ground. The porphyritic points, in these rocks, are distinctly compound; generally four distinct crystals being combined in each. These are arranged in two pairs, one of which is usually comparatively large, so that, at first sight, the porphyritic point would seem merely double. The crystals of the two pairs are placed at different angles, so as to reflect the light at different points of view, and it was this circumstance which led me to observe this peculiarity. This I have found common, as a general rule, to all the Porphyritic rocks in the State, and indeed, in a greater or less degree, to the structure of all the Primary rocks. This porphyritic structure is a part of the parallel structure of the rocks, in which it is observed, but the porphyritic points are usually placed at an angle distinctly oblique to the general direction of the grain or stratification of the rock. Indeed, this oblique position of the parts is characteristic of the entire Primary structure, and may be traced, from the smallest points to the largest interposed beds of Granite. The larger porphyritic crystals are generally surrounded, particularly at their extremities, by smaller crystals of Felspar, and by the relative diminution of the former, and increase of the latter, the porphyritic point presents the appearance of an interposed nodule of finer-grained Felspar. Generally the porphyritic points are arranged in a series, in the direction of the grain of the rock, and nearly or quite connected at their extremities. In the same manner, the porphyritic nodules, just described, are arranged in the general line of direction, thus presenting the appearance of interrupted veins. Instances occur in the present formation (D,) where the passage from the porphyritic to this interrupted veined structure is quite obvious. This fact I have considered as offering a connexion between the simple Porphyritic structure, and the large detached interposed beds or veins of Granite, which are so common in many of the Primary formations of the State, and as indicating a common mode of formation. This subject will be further considered, in connexion with those formations

in which such Granite beds are frequent, particularly E W. & B 3 and C 1 E. The large Porphyritic rocks of the present formation usually occur in thick beds, interstratified with more schistose sub-porphyritic or micaceous varieties. The latter have often the appearance of a Mica Slate, accompanied with garnets, but with a physical character peculiar to this formation. The Porphyritic beds often have an obviously detached arrangement, like the interposed beds of Granite, just noticed, but still with a structure distinctly parallel.

This formation, like the preceding, presents several distinct subordinate parts.

1. Along its Eastern border, apparently throughout its entire length, from Golden Hill (Bridgeport,) to the point where it meets the Secondary, extends a rather narrow range, characterized by large Porphyritic beds, generally with a light grey, coarse-grained, slightly fissile ground, with large porphyritic points of white Felspar. These porphyritic points are generally in distinct relief on the weathered surface of the rocks, giving to these a peculiar appearance, obvious at a distance. These Porphyritic beds alternate with a thinner, more micaceous and schistose rock; sometimes more felspathic and subporphyritic; sometimes very micaceous, and then often quite decomposible, and occasionally accompanied with garnets. The Mica, in these varieties, is of a light steel-grey, with a peculiar lustre. Occasionally, alternate beds occur of a coarse or fine white Felspathic (Granitic) rock, which sometimes, particularly in that part of the range East of Huntington village, is distinctly porphyritic in its structure, but with a stronger tendency to the interrupted veined structure, already noticed.

The passage into the formation (C,) along the Eastern border of the present range, has been already noticed. This range extends N. N. E. from Golden Hill, along a valley opening from Bridgeport Harbour to the Housatonic, opposite Derby; rising more or less on the Western slope of the high ridge, West of that river, occupied by the formation (C.) It passes through the villages of Derby and Birmingham, where it is

quarried for building; then extends along the West side and summit of the highest ridge, between the valleys of the Naugatuck and Milford rivers, and bearing more N. Easterly, passes East of Bethany meeting-house, and at last meets the Secondary near the N. E. corner of that town.

In the Southern portion of the present formation (D,) South of the narrow point, already noticed, in Huntington, a rather wider band (2) occupies its middle part, consisting chiefly of a dark grey sub-porphyritic, or small porphyritic rock, with more or less Hornblende disseminated, and with occasional beds of a dark sub-porphyritic Hornblende. The mica of this range is black, with shades of dark green, giving the rock a peculiar aspect. Sometimes the Felspar is reddish. This rock is generally quite decomposible, and its colour is then more distinctly greenish. It is also then quite ferruginous. It usually breaks in rather small jointed fragments. In its N. Eastern portion, it preserves quite a uniform character throughout its entire width. Farther S. W. a central band (3) commences not far from Thatchersville, N. of Bridgeport, consisting chiefly of large beds of a light grey, sometimes nearly white, Felspathic (Granitic) rock, distinctly parallel and stratified, and usually even and fine-grained. It sometimes, particularly when of a bluish grey colour, breaks into small prismatic fragments; at other times, when lighter coloured, it may be quarried in large even slabs, as at Burr's Quarry, East of Ash Creek (Fairfield.) It alternates with a light grey micaceous rock, similar to that alternating with the large Porphyritic beds of (1,) and less frequently with a dark micaceous sub-hornblendic rock, similar to that of (2,) and like it very decomposible.

N. W. of Bridgeport, between the Porphyritic rocks of Golden Hill, and the range (3,) commences a range (4) of a Micaceous silver-grey, thinly fissile rock, accompanied with garnets, and occasionally with small tortuous veins of Quartz and Felspar, and resembling the more micaceous alternations of range (1) of the present formation, rather than the rocks of the preceding formation (C.) This rock illustrates well the insuf-

ficiency of the old terms Gneiss and Mica Slate, in determining the arrangement of the Primary rocks, for at times such is the predominance of Quartz that it might be justly called a Mica Slate, while at other times the presence of Felspar is distinctly obvious; but throughout it preserves a peculiar character, which identifies it with the present formation (D.) It alternates with subordinate beds of the dark sub-porphyritic rock of (2,) which become less frequent towards the S. W.

Along the Western border of the present formation (D,) West of the range (2,) extends a band (5,) generally quite narrow, characterized, like the range (1,) by beds of large Porphyritic rock, with white, and occasionally red Porphyritic Felspar. The latter is most abundant towards the S. W. in Fairfield. These beds alternate with a steel-grey, more or less sub-porphyritic, thinly fissile Micaceous rock, similar to that of ranges (1) and (4,) but with some peculiar differences, which also forms the passage into the adjoining formation next West (E.)

West of a point N. W. of Black Rock, the arrangement of the formation is somewhat changed. The range (4) extends along the low grounds adjoining the coast, near the mouth of Ash Creek; the range (3) extends along the S. side of the ridge N. of Fairfield village; while the ranges (2 and 5) extend along the summit of the same ridge to the vicinity of the Church, E. of Mill river. The two latter are here more intermingled than farther East, though the large Porphyritic beds are generally found on the N. W. Still farther N. W., and adjoining the valley of Mill river, there extends a range (6) of porphyritic or sub-porphyritic veined rock, adjoining the formation next West (E,) with dark and occasionally greenish Mica, and traversed by beds of coarse white Granite, and very light grey Granitic Gneiss.

The formation (D,) West of Mill river, presents a somewhat different arrangement. Adjoining that stream on the West, and parallel with it, extends a range of light grey, very micaceous rock (7,) accompanied with garnets: partly finer

grained, and more resembling the rock of range (4,) and partly coarser grained, and bluish, more resembling the rock of the formation next West (E.) This occurs in both banks of Mill river at Southport, where it is accompanied with beds of coarse White Granite. The interval between it and the range (4,) along the coast, South of Fairfield village, is so covered with Diluvium, that I have not been able to determine whether it communicates with that range, or not. Its direction, along the West side of Mill river, towards the formation (E,) and the resemblance of its rocks, in part, to those of that formation, would seem to indicate its connexion with the latter. It is, however, separated from it by an intervening range (8,) extending S. W. from the valley of Mill river, S. of Greenfield, to the Sound, at Compo Creek. This range consists of a dark grey sub-porphyritic, sub-hornblendic rock, similar to that of range (2;) generally decomposible; sometimes, particularly when more hornblendic, breaking into nodular fragments, and decomposing by concentric layers, like a similar rock in Greenwich, to be hereafter described; sometimes very prismatic, when it is usually ferruginous, with greenish mica and red felspar. Beds of sub-porphyritic Hornblende occur in this range; one of which, East of Compo Creek, near its mouth, decomposes on the surface into a black earth, resembling coal dust, for which it has been mistaken. The porphyritic veined rock of range (6,) extends, in a narrow band, at least partly along its Western border, where it forms the transition to the formation (E,) next West. It occurs in this position, between the valley of Mill river and Greenfield, and towards the S. W. in Greensfarms, both N. and S. of the New York Turnpike. It there includes beds of coarse white Granite and light grey Granitic Gneiss, the latter sometimes alternating with a dark blue, veined micaceous rock, similar to that of the formation (F,) to be afterwards described. A light bluish grey prismatic Granitic Gneiss, similar to that of range (3,) occurs on Sasco Creek, between ranges (7) and (8,) at the passage of the New York Turnpike.

Returning N. E. to the narrow point, in Huntington, nearly the entire width of the formation is occupied by the Porphyritic range (1,) from the N. E. point of range (2,) near the S. E. corner of Trumbull, to the Housatonic. This Porphyritic range (1) is here bounded, on the West, by an extensive range of White Felspathic (Granitic) rock, which will be noticed under the next formation (E.) This Granitic range might perhaps be regarded as a continuation of the Granitic range (3,) in the present formation. It is, however, separated from the present formation, in its Southern part, by a process of the peculiar Micaceous rock of the formation (E,) within the limits of which latter, it also commences on the S. W. It extends N. Easterly to the S. bank of the Housatonic, not far above Derby. A narrow band (9) intervenes between it and the Porphyritic range (1,) N. of the N. E. point of the range (2,) consisting of a very Micaceous ferruginous rock with garnets, and with occasional beds of Hornblende, and of a coarse white Granite, marked by intersecting plates of dark Mica (*Pseudomorphous Granite*—Hitchcock.) At its North point, where it crosses the Housatonic, and apparently bends round the N. point of the Granitic range, last noticed, this band (9) includes subordinate beds or layers of a very fine grained, dark blue quartzy pyritiferous Slate.

A narrow range (10) extends S. from the Housatonic, along the West side of the Granitic range, last noticed, to a point not far S. W. of Huntington village, consisting of alternate beds of Porphyritic, sub-porphyritic, and micaceous rocks, rather resembling those of range (5,) than those of range (1,) but with some peculiar characteristics. The mica is usually dark, the rock harder, and the felspar often yellowish (ferruginous.) Hornblende is occasionally disseminated, and beds occur of a finer grained, very dark grey, sub-porphyritic ground, with large square porphyritic points of purple felspar, with minute scales of black mica disseminated through them, as in a large Porphyritic rock in Litchfield (G ζ.) This range (10) is continued North across the Housatonic, and extends along a high

ridge, West of the Naugatuck, where it is traversed by the Second Western Trap Dike, and includes, adjoining the latter, veins with Mispickel (Bassett's mine.) Adjoining it on the East, in the angle between the Housatonic and the Naugatuck, is a range with beds of light grey granitic gneiss, with micaceous alternations, nearly in the line of the Granitic range, S. of the Housatonic, last noticed. Adjoining the range (10,) S. of the Housatonic, the Western boundary of the present formation (D,) is less distinctly marked than in other parts of its course; but this point will be better explained, under the next formation (E.)

N. E. of the Naugatuck, the outlines of the present formation (D,) are quite distinctly marked. Its Eastern boundary has been already noticed. Its Western limit is marked by an almost uninterrupted range of the peculiar Micaceous rock (α) of the next formation (E,) which will be described under that head. The general arrangement of its subordinate parts is here similar to that in the more Southern part of its course. The Porphyritic range (1) is continued along its Eastern border, as already explained. West of this, the greater part of the formation is occupied by a range (11) of dark grey sub-porphyritic, or smaller porphyritic rock, more or less veined in its structure, and occasionally sub-hornblendic, in which are included subordinate beds or ranges of a very light grey Granitic Gneiss, generally even, and suitable for quarrying, with dark silver-grey micaceous alternations. The most extensive of these (12) apparently traverses the middle of the formation, and may be considered a continuation of the Granitic ranges, farther S., already noticed. It extends from the Naugatuck, above Derby, by Bethany meeting-house, and terminates on the border of the Secondary, S. E. of Prospect. Near its Northern termination, it is accompanied with small beds of impure Limestone. There also extends through the middle of the formation, and apparently in connexion with the range (12,) a series of beds of a very fine-grained, light bluish grey ferruginous rock, accompanied in some instances with Mispickel. This line

crosses the Humphreysville Turnpike near the gate S. E. of that village, and is observed in various points S. W. of Bethany, particularly West of the North branch of Bladen's brook. It is apparently in the same range with Bassett's Mine, already noticed; and still farther South, in the Granitic range S. of the Housatonic, referred to the formation (E,) near its Western border, particularly at a point S. of Huntington village, similar beds are observed, with traces of Limestone, resembling that at the Northern termination of (12,) just noticed. Farther researches may perhaps prove this a mineral range of no little importance.

North from Humphreysville to the Straits (Litchfield Turnpike,) the present formation (D) interlocks much with the next formation (E.) In different points, where it adjoins that formation, occur subordinate tracts of large Porphyritic rock, and also of a peculiar silver grey, coarse flaky Micaceous rock, often very ferruginous, and with interposed beds of coarse white Granite. In one locality near the Litchfield Turnpike, plumbago has been found in the Micaceous rock last noticed. North from the Straits, the two formations (D and E,) extend parallel to each other, in a very even line, N. N. Easterly, to a point not far N. E. of Prospect meeting-house. The rocks of the formation (D) are here chiefly dark grey sub-porphyritic and porphyritic, like those of (11,) with micaceous and granitic beds occasionally interposed. Along its Western border, immediately adjoining (E,) in a valley S. E. of Prospect village, extends a narrow band of dark green Hornblende, with an interposed bed of white Limestone, formerly quarried. N. E. of Prospect, adjoining the Cheshire and Waterbury road, the formations (D and E) are apparently intermingled; bands of the micaceous rock (α,) peculiar to (E,) being interposed between the Porphyritic and sub-porphyritic rocks of (D,) along the Western border of the latter. Farther North, the two formations are separated by a distinct boundary, extending along the declivity of the mountain, rising West of the Secondary valley, in Southington.

Near the N. Eastern point of the present formation (D,) some peculiar varieties of rock present themselves. Adjoining the Meriden and Waterbury Turnpike, a large red Porphyritic rock occurs, with dark sub-porphyritic, and dark micaceous-hornblendic alternations. Farther North, at the termination of the formation, the prevalent rock is lighter grey, more granitic, sub-porphyritic, and more rarely small porphyritic, with large beds of a nearly white very felspathic granitic gneiss. A similar white granitic gneiss, with ferruginous micaceous alternations occupies a narrow band between the red porphyritic rock, just noticed, and the formation (E,) on the West. Adjoining the N. point of the present formation (D,) on the West, is a range of beds of dark green Hornblende rock, similar to that accompanying the Limestone, S. E. of Prospect.

The Second, or more Western Trap Dike, in the Western Primary, traverses the present formation (D,) through the greater part of its extent, as will be afterwards explained.

Viewed as a whole, the formation (D) presents on each of its two borders, a range characterized by large porphyritic rocks, while its central part is occupied by darker grey sub-porphyritic rocks, traversed by a range, characterized by beds of granitic rock. The micaceous rocks, accompanying the latter, may be considered as expanding on the S. W. into the subordinate ranges (4) and (7.) This formation, as it approaches the coast, at Bridgeport, apparently bends more to the West, in the direction of the coast, in the same manner as the Chloritic formation (A,) already noticed. The porphyritic range (1) terminates, however, at Bridgeport. At its S. W. termination, the formation (E) bends again more to the South around the present formation (D,) indicating a new curve in the direction of the Primary System. Towards the N. E. the subordinate ranges of this formation, terminate successively farther N., in the same manner as has been already noticed in the Chlorite Slate and Argillite formations (A—B;) the most Eastern range (1) terminating, on the South, in the N. E. corner of Bethany,

and the most Western range extending to a point several miles farther North in Southington. Near its Northern termination, this formation is apparently directed more to the North, in the same manner as the formations farther South. I have not observed any formation analogous to it, on the opposite side of the Secondary, within the limits of the State.

E. *A Micaceous Formation* (Mica Slate.)

This formation is still more irregular in its outline than the preceding, and may be rather considered as a range, along which a very peculiar Micaceous rock (α) is distributed, in tracts sometimes apparently quite isolated, but in a general line of direction, N. Easterly. This rock is combined with others of a different character, forming alternate or adjacent tracts; the whole, combined, serving to complete the continuity of the formation. Thus considered, the formation extends from the Sound, East of the Saugatuck, N. Easterly, in a very undulating course, to the S. E. corner of Wolcott. It does not, however, there terminate, but expands in that town, and extending North and West, unites with a Micaceous formation (G,) to be afterwards described. Under the present head, I shall describe this formation only to the point, where it begins to extend Westerly, nearly West of the Northern termination of the preceding formation (D.)

The rock (α,) peculiar to this formation, is a very coarse-grained, flaky or plated Micaceous schist, of a peculiar bluish silvery colour, with a soft silky talcose lustre, generally accompanied with garnets, and often with staurotides. Kyanites also accompany it, particularly adjoining veins of limpid Quartz, which are not unfrequent. In different places, throughout a considerable part of its extent, seams occur of a peculiar white, delicately fibrous Talc, perhaps associated with Bucholzite. Two of these localities are worthy of notice, namely, one on the West bank of the Pequanock, near Trumbull meeting-house, and another at the passage of a branch (6) of this formation across the Housatonic, not far East of Five Mile

river (Oxford.) These two points apparently indicate the course of a range, in which this peculiarity is of most frequent occurrence. I have noticed it in several intermediate localities, and in others farther S. W.

This coarse-grained Micaceous rock (α) is generally slightly fissile, and very tortuous. It is usually distinctly felspathic; the felspar of a pure white (albitic,) and occurring in veined porphyritic points, or in small porphyritic veins. Large beds of interposed, very coarse-grained Granite, with a similar white Felspar, are not unfrequent in this rock, and indeed may be considered characteristic of the range. These beds are usually interrupted at short intervals, and in many instances, succeed each other, in a series of links, gradually running out, and closely resembling, on a large scale, the small porphyritic Felspar veins, in the Micaceous rock inclosing them. Their analogy to the porphyritic points of Felspar, in the preceding formation, has already been hinted at.

Beds of a finer grained, more quartzose, silver grey Mica Slate, generally more even and fissile, but sometimes thicker, and forming rather a variety of Micaceous Quartz, are occasionally interposed in the coarser-grained Micaceous rock (α.) This latter is generally accompanied, throughout its course, by lateral or alternate tracts of a more felspathic, porphyritic or sub-porphyritic veined, dark micaceous seamed Gneiss (β,) generally quite hard, and not unfrequently accompanied with garnets. It resembles strikingly, in its structure, the more felspathic varieties of the Micaceous rock (α,) and differs from the porphyritic and sub-porphyritic rocks of the preceding formation (D,) by the less detached position of its felspar, and the arrangement of the latter in more continuous seams or veins, with interposed seams or layers of mica. The tendency, however, to the porphyritic structure is very obvious, causing a continual enlargement and contraction (sometimes an interruption) of the seams or veins. Isolated tracts of white felspathic (Granitic) rock also occur, in connexion with this formation, which will be afterwards more particularly noticed.

Beds of white Limestone occur, in detached points, either associated with the Micaceous rock (α,) or with other rocks, accompanying the latter, throughout a great part of the course of the present formation (E.) Beds of Hornblende also accompany this formation, particularly in connexion with the porphyritic veined rock (β,) more or less resembling it in structure, and like it, often containing garnets.

I shall not here attempt to describe all the irregularities and interruptions in the course of the Micaceous rock (.) It extends, however, apparently in an uninterrupted range (1,) from the Sound, East of the Saugatuck, to Greenfield village, and thence along the West side of Mill river, to a point nearly East of North Fairfield (Weston,) where it appears to terminate. A branch of it (2) crosses Mill river, near the Black Rock and Weston Turnpike, and extends Easterly, by the Baptist meeting-house, in the N. E. part of Fairfield, round the S. W. point of the Granitic range of Huntington (10,) noticed under the preceding formation, and may be traced distinctly along the Eastern border of that range as far as the Pequanock in Trumbull, and may perhaps be regarded as continued in the narrow Micaceous band (9 D,) already described. The main portion (3) of this Eastern branch (2) is continued along the West side of the Granitic range (10) through the centre of Trumbull, where it expands to a greater width, and again subdivides into two branches; one (4) continued along the West side of the Granitic range (10,) and of the South point of the branch (10 D) of the preceding formation, at least to Huntington village; the other (5,) passing through the Eastern part of Monroe, probably to the Housatonic. A range (6) of this Micaceous rock (α) crosses that river, below Five Mile river (Oxford,) nearly in the same line as the range (5,) and like that characterized by the white talcose seams, already referred to. This range (6) bends Easterly, along the North side of the Housatonic, to the neighbourhood of the Lime Quarries, above Derby, whence it extends N. Easterly to the Naugatuck, and then along the West bank of the latter, in a narrow rocky

ridge, to Humphreysville. Farther North, it is continued along both sides of the Naugatuck, with a very irregular outline, to the range of Beacon Mountain (7.) In this part of its course it is much intermingled with the porphyritic and subporphyritic rocks, on the Western border of the preceding formation (D,) on the East, and with similar rocks (β) of the present formation, on the West. At Beacon Mountain (7,) the Micaceous range (α) forms a remarkable expansion, extending nearly East and West, from a point about two miles West of the Naugatuck, to the Straits at the Litchfield Turnpike. It then bends N. Easterly, in a high narrow ridge (8) passing through Prospect village. North of Prospect, its course is indistinct, being apparently interrupted, and blended with rocks of the preceding formation, as already noticed; but South of the Meriden and Waterbury Turnpike, it again forms a continuous ridge (9) extending along the summit of the mountain, West of the Secondary valley (Southington,) to the point, where it expands Westward.

The Micaceous rock (α) is accompanied, throughout its course, by other associated ranges, as already noticed; the most remarkable of which, is the Granitic range of Huntington (10.) This commences, on the S. W., near the Bridgeport and Newtown Turnpike, in the S. part of Trumbull, traverses that town N. Easterly, East of the meeting-house, and then passing along the ridge East of Huntington village, terminates on the S. side of the Housatonic, not far above Derby. This range consists chiefly of a white very felspathic rock, with seams of white mica, distinctly parallel in its structure, and usually schistose, with subordinate alternations of a dark grey Micaceous rock, and occasional beds of Hornblende. The latter are most abundant on its Eastern and Western borders. Beds of coarse White Granite also occur, particularly along its Western border, where it approaches (10 D.) One of these, East of Huntington village, incloses a large vein of pyritiferous Quartz. In different points along its Western border, N. E. and S. E. of Huntington village, occur subordinate beds of

a light bluish grey, fine-grained, sub-micaceous ferruginous rock, accompanied with traces of Limestone, already noticed in connexion with a similar range, traversing the central band (12) of the formation (D,) farther N. E. The Trap Dike connected with (D) traverses this range (10,) from near the Bridgeport and Newtown Turnpike, on the S. W., till it enters (10 D,) at the S. W. point of the latter. This range (10) might be considered as in the same line with the Granitic ranges connected with the formation (D,) namely (3,) farther S. W., and (12,) farther N. E.; but it commences distinctly on the S. W. within the limits of the present formation (E,) and at a point, considerably to the N. W. of the N. E. point of (3D.) The granitic rock, too, of this range is generally whiter and more felspathic, than that of the latter range; resembling, in this respect, the coarse granite beds connected with the micaceous rock (α) of the present formation. The range (12D) is apparently more directly in its line, and also more analogous in its character. Granitic ranges, of smaller extent, but of similar character, occur in other parts of this formation, particularly in the Micaceous range (4) S. W. of Huntington village, and on the S. W. side of the range of Beacon Mountain, West of the Naugatuck; there rather in connexion with the porphyritic veined rock (β,) adjoining the Micaceous range (α) on the West.

I will now give a brief outline of the arrangement of the porphyritic veined rock (β,) accompanying the present formation. The range (6D,) already noticed under the preceding formation, as skirting the Micaceous range (1) of the present formation, on the East, in the neighbourhood of Greenfield, and farther S. W., is of a similar character. A rock of a similar character also occurs on the Western border of the range (1,) East of the valley of the Aspetuck, sometimes including seams or nodules of compact Chlorite. A range of the same rock (11,) is also interposed between the branches (1 and 2) of the Micaceous rock (α,) commencing on Mill river, below the Rock-House Turnpike (Fairfield,) and extending along

the West side of the Micaceous range (2—3) through the N. W. part of Trumbull into Monroe. The rock of this range is generally very fragmentary; unbroken ledges rarely appearing on the surface. It is occasionally accompanied with large beds or subordinate ranges of Hornblende. This is the case, where it approaches the Micaceous rock of (1) on the ascent of the ridge West of Mill river, at the Rock-House Turnpike. An extensive and apparently isolated range of Hornblende (12) occurs in Trumbull, near the line of Monroe, on the Western border of the Micaceous range (3,) including the Limestone beds, at Lane's Trumbull Mine, traversed by veins of Topaz rock, with fluor, and different metallic ores (Copper, Tungsten, &c.,) and along the East side of the Newtown Turnpike, on its S. W. border, a series of beds of coarse white Granite, alternating with pyritiferous beds in the Hornblende. In the interval between the two branches (4—5) of the Micaceous rock (α,) commences a wide range (13) of the same porphyritic veined rock (β,) extending through the N. W. part of Huntington to the Housatonic, and underlying the Micaceous rock (α,) as it bends E. along the N. side of that river. This range includes two or three subordinate bands of the bluish silvery Micaceous rock (α,) and apparently passes, on the East, into the Porphyritic range (10 D.) North from the Housatonic, to its Northern termination, the Micaceous rock (α) of the present formation, is usually accompanied, along its Western border, by a band of the same porphyritic veined rock (β,) very generally with garnets disseminated, and sometimes associated with beds of a large porphyritic rock, similar to that on the Western border of (D.) This is particularly the case on the West side of the Naugatuck, from Humphreysville to the S. W. point of Beacon mountain, where the range of Micaceous rock is very narrow, and irregular in its outline. Beds of Hornblende frequently accompany the porphyritic veined rock (β,) particularly at its junction with the Micaceous rock (α.) Traces of copper are observed in a bed of Hornblende, in that position, West of the Naugatuck at Pines' Bridge (Oxford.) In that part of the

present formation, extending from the West point of Beacon mountain, to its Northern termination, the sub-porphyritic veined variety of Hornblende, with garnets, is generally found along its Western border, in connexion with the porphyritic veined rock (β.)

The detached deposits of White Limestone, accompanying the present formation, have already been hinted at. This is a pure limestone, sometimes quite free from imbedded minerals, and of a pure white, sometimes more or less blended with different minerals, particularly hornblende, pyroxene and mica, and at times, very ferruginous, from the presence of iron pyrites. A bed, chiefly composed of the latter mineral, is included in the North lime quarry, at Quaker's Farms (Oxford.) Generally the beds of limestone are associated with beds of hornblende and pyroxene. This series of Limestone beds, may be traced, in detached points, from a locality near the Eastern line of Westport, not far North of the New York Turnpike, to the locality, already noticed under (D,) in Prospect. These beds are found more usually in the rocks adjoining the Micaceous rock (α,) but sometimes in that rock itself. The locality East of Westport, is in the latter position, and the limestone is there much blended with other minerals. The Limestone at Lane's Mine (Trumbull,) is associated with the Hornblendic range (12,) in which connexion it has already been noticed. The quarries, S. of Quaker's Farms (Oxford,) are situated in a range of sub-porphyritic rock, not far West of the point, where the Micaceous range (6) crosses the Housatonic. They will again be referred to under the next formation (F.) The quarries on the Housatonic above Derby (Bassett's) are situated partly in the Micaceous rock (α,) near the point where it bends N. E. towards the Naugatuck, and partly in the sub-porphyritic veined rock (β) underlying it on the South. Small beds of Limestone, accompanied with Hornblende and Pyroxene, occur in the same porphyritic veined rock, underlying the Micaceous rock (α) on the West, in a ridge on the West side of the Naugatuck, North of Humphreysville. The position

of the Limestone in Prospect has already been noticed under (D.)

The small Trap Dike, in the S. E. corner of Wolcott, is near the West border of the Micaceous rock (α) of the present formation, and nearly in the line of a series of beds of garnetiferous Hornblende, a short distance N. E.

By recurring to the map, it will be seen, that the present formation (E) advances in its general N. Easterly direction, by a series of undulations towards the East, a fact which may be observed of the whole Primary System of the State. It first extends more N. N. Easterly, along the east side of the Saugatuck; then more Easterly, through Greenfield, into Trumbull; then again more N. N. Easterly to the Housatonic, along which it bends Easterly, and is then directed N. N. E., and even Northerly, along the Naugatuck, to Beacon Mountain, where it bears nearly East, to the Straits, and then is again directed N. N. Easterly to its termination. The direction and dip of the strata are very variable, as might be supposed, from the irregularity of its course. Throughout a considerable part of its extent, however, its dip inclines to the East. This inclination also affects, to a greater or less extent, the Western border of the preceding formation (D.)

F. (Gneiss.)

Under this head, is comprehended a group of formations, rather than a single well marked formation. They are, however, combined in such a manner, as to present a distinctly systematic arrangement. The rocks, included under this head, may be arranged in three general classes, namely: 1st, A dark blue micaceous rock, finer grained and harder, than that of the preceding formation (α E,) generally abounding in small Granitic seams or veins, and then much contorted, and alternating more or less with beds of Felspathic (Granitic) rock, which often largely predominate, so as to give a character to such parts of the formation. The Granitic rock is, indeed, the most abundant, throughout the greater part of the district, where

this class of rocks occurs, namely, the S. E. part of the present division (F,) so much so that this part of (F) might well be called a Granitic formation ; still the Micaceous rock is the most distinctly characteristic. 2d, Different varieties of Porphyritic and sub-porphyritic rock, occurring in a series of detached local formations, throughout a great part of the extent of the entire range (F,) and with characters differing more or less in the different formations. 3d, A dark grey, silvery shaded Micaceous rock, more or less veined and contorted, like the Micaceous rock of the first class, and like that too, abounding more or less in Granitic alternations, or subordinate formations. It extends in a range along the Western border of the present division (F,) and also occupies the greater part of its N. Eastern portion, North of the Housatonic, presenting a greater number of varieties than occur in the rocks of the first class.

The entire range (F) extends from the Sound, in a N. Easterly direction, to the extension of the Micaceous range (Eα) Westward, already noticed. It adjoins the Sound, on the South, from the Saugatuck Westward, till it enters New York State. On the East, it is bounded by the preceding formation (E ;) on the N. E. by the extension of the latter Westward (G1 ;) on the N. W. (towards the North,) by an extensive Micaceous (Mica Slate) formation (G 3,) traversing Litchfield Co., and connected with the extension of E (G1,) and (towards the South,) by the Calciferous range (H,) next west in the series. The general direction or axis of this range is quite N. E. It extends, in a wide band, through the centre of Fairfield Co., and through the N. W. part of New Haven Co., and just enters the S. E. corner of Litchfield Co.

Before proceeding to any farther remarks upon it, as a whole, I will briefly describe the more important subordinate formations of which it is composed ; beginning at its S. W. point, where it enters Greenwich, from New York.

(1.) A dark micaceous sub-porphyritic and porphyritic formation, generally with more or less Hornblende disseminated, oc-

cupying a considerable part of the towns of Stamford and Greenwich, and extending along the Sound, from the East side of Stamford Harbour into New York State. The most characteristic rock of this formation is a very dark micaceous sub-hornblendic rock, generally very decomposible, and cleaving concentrically, like the rock, in Greenfield, noticed under (8 D,) and accompanied with thicker bedded alternations, of a similar composition, but less decomposible, with porphyritic points of purple Felspar. This latter variety often breaks in large square blocks, like Trap. These two varieties more generally occur along the N. W. border of this formation, between Byram and Miannus rivers, in Greenwich. Subordinate ranges, more abundant in the central part of the formation, present a lighter grey variety, more felspathic veined or striped, and less decomposible, but still characterized by seams of dark Mica. This rock is generally quite even and fissile, and is much quarried in Greenwich, for flagging and coarse constructions. Usually it contains very little Hornblende disseminated. Along the Eastern border of this formation, particularly North of Stamford village, is a subordinate range of a light bluish grey, large porphyritic, thicker bedded rock, with sub-porphyritic alternations, similar to the variety last noticed. Subordinate ranges, generally of moderate width, of a rather coarse-grained stratified or parallel Felspathic rock (Granitic Gneiss,) quarried, quite extensively, as Granite, in Greenwich, traverse the formation, accompanied immediately by more micaceous, less sub-porphyritic beds, than those occurring in most other parts of it. Beds of coarse White and Red felspathic Granite also occur, with similar associations, as the latter. A range of beds of a coarse White Granite, just West of Stamford village, alternates with a very Micaceous rock, with garnets. Subordinate ranges of Hornblende also occur; partly of a uniform dark green, and rather thinly shistose; partly thicker bedded, and sub-porphyritic (Sienitic.) A small isolated range of the latter kind, occurs on the Eastern border of the present formation, West of Noriton river (Stamford.) This is generally very

thick and massive, composed chiefly of Hornblende, and breaking in large prismatic trap-like blocks. Beds of Serpentine occur in this formation, in West Greenwich and Rye, (N. Y.) The subordinate beds and ranges (Granitic and Hornblendic,) accompanying this formation, are apparently of no great extent, in the same line of direction, but are subject to interruption, and either isolated, or succeeded by other similar ranges, in a different line. This fact is indeed common to the whole Primary arrangement. The present formation (1) is surrounded by rocks of the first and third classes: by those of the first class, on the East, and by those of the third, on the N. W. and North. The rocks of each class assume a peculiar character, near the line of junction with this formation, as will be hereafter noticed. The two divisions marked by the rocks of the first and third classes, meet near the village of North Stamford, and the peculiar varieties adjoining the formation (1) are apparently continued, some distance, in a range extending N. Easterly from that point, between the two divisions.

(2.) An extensive range, East of (1,) chiefly occupied by the dark blue micaceous veined and Granitic rocks of the first class. This range extends along the Sound, from the preceding formation (1,) to the Saugatuck, and in a N. E. direction to the borders of Newtown and Monroe. Its outline, in the latter direction, is very irregular; it being succeeded in the line of its bearing, by a series of porphyritic rocks (6,) the two ranges mutually indenting each other, or processes from the main body of each, extending into the other, to a greater or less distance. The greater part of the present range (2) is composed of the two leading rocks of the first class (the dark blue micaceous veined, and the white Felspathic or Granitic.) These two rocks predominate respectively in different portions of the range; the Felspathic, especially, apparently forming a series of isolated sub-formations, with ranges, in which the micaceous rock predominates, interposed. The micaceous rock of the present range (2) frequently has a distinctly talcose aspect. This is particularly true of a subordinate range, near

its Eastern border, East of the Aspetuck, in the S. E. part of Weston, in which the rock is also very ferruginous. It is more remarkably the case with another subordinate range, (to be hereafter described,) adjoining the formation (1,) on the East, in the valley of Noriton river. The Granitic rock of the present range (2) is generally white felspathic, hard, and sometimes very prismatic, and usually with parallel seams of white or slightly bluish Mica. The most extensive subordinate ranges of this rock, are between the Saugatuck and Norwalk rivers, adjoining the Sound, and in the Northern part of a very rocky tract, called the Devil's Den, near the borders of Weston and Reading. This latter is perhaps rather on the Eastern border of the rocks of the third class. In these two subordinate ranges the Granitic rock largely predominates. In other parts of the range (2,) the Micaceous and Granitic rocks are either more equally distributed, or the former predominates. Still, smaller tracts frequently occur, in which the Granitic rock prevails, particularly on both sides of the mouth of Noriton river; West of the mouth of Norwalk river; in the high ridge between Norwalk river and the Norwalk and Newtown Turnpike, North of Norwalk Borough, on the East side of which it breaks in very small prismatic fragments; and in a ridge S. W. of Wilton village, and East of New Canaan river.

Along the Western border of the range (2,) where it approaches the formation (1,) there frequently occurs a coarser-grained, dark blue, more talcose Micaceous rock, often with thick seams of a greenish Talc, and with included granitic beds, generally coarse-grained, with red felspar, and also with seams of a light greenish Talc. These sub-talcose rocks occur especially adjoining the valley of Noriton river, and apparently extend in a N. E. direction to New Canaan village. The country, throughout their range, is generally, however, very much covered with Diluvium, the rock appearing on the surface, only at remote intervals. I have already observed, that a subordinate range extends N. E. from the N. E. point of the formation

(1,) separating the rocks of the 1st and 3d classes of (F.) The basis rock is there a darker (nearly black) micaceous schist, with beds and veins, rarely large, of a generally coarse-grained red and white felspathic Granite, and also with beds of Hornblendic and sub-hornblendic rock, and in some instances with small beds of Asbestos Hornblende. This subordinate range extends along a valley opening N. Easterly, from the valley of Mill river (near North Stamford,) North of New Canaan.

Within the limits of the range (2,) occur several smaller tracts of sub-porphyritic and porphyritic rock, similar to that of the Greenwich formation (1.) The most remarkable of these (α) occupies a considerable extent in the South part of Darien, and is bordered on the North, by small ranges of Hornblende, partly sub-porphyritic (Sienitic,) with beds of coarse Granite, accompanying them. Subordinate tracts of Granitic rock also traverse the sub-porphyritic rock, as in the Greenwich formation. The rock of this range is generally with a very dark micaceous, often sub-hornblendic ground, with smaller white, and larger purple porphyritic points of felspar. Like the sub-hornblendic varieties of Greenwich, it is often very decomposible. It is separated from the formation (1,) by the Granitic tract, at the mouth of Noriton river, already noticed. Another tract of smaller extent (β,) ranging in a N. Easterly direction, traverses a ridge between Norwalk and Five Mile river, S. of the New York Turnpike. This is quite narrow, and is interposed between the blue micaceous rocks of the present range (2.) The rock is less sub-porphyritic than that of the former tract, is distinctly sub-hornblendic, and of a dark green colour, with porphyritic chloritic patches of a lighter green, very striking on its weathered surface. A large plain at the junction of the Saugatuck and Aspetuck rivers, is apparently underlaid by a similar sub-porphyritic rock (γ,) also greenish and sub-chloritic, with thicker bedded, more hornblendic alternations. The rock is here very decomposible, and rarely appears unbroken on the surface. This subordinate range apparently extends some distance S. W.

through a valley opening towards Norwalk Borough (that of the Newtown Turnpike,) where it is accompanied with a light green Pyroxenic rock, with traces of Limestone. N. E. from this plain, within the limits of (F,) East of the Saugatuck, the rocks of the 1st and 2d classes are much intermingled, in apparently alternate ranges; those of the 1st class diminishing, and those of the 2d class enlarging into the extensive Porphyritic formation (6,) in Monroe. In these ranges of the 2d class, large porphyritic rocks occur, similar to those of the main formation in Monroe.

Subordinate beds of Hornblende, both uniform and thinly schistose, and sub-porphyritic (Sienitic,) occur at different points, in the Micaceous and Granitic rocks of the range (2;) generally associated with a darker, more ferruginous variety of Micaceous rock, sometimes greenish and sub-chloritic. The particular direction of the present range (2) will be better explained, after having completed the details of the entire range (F.)

3. Under this head I include the rocks of the 3d class, extending from New York State, through the Northern part of Greenwich, Stamford and New Canaan, into the limits of Wilton and Ridgefield. The line of the State, along the N. border of the three first of these towns, passes through this range, for the greater part of its distance. This range (3) is interposed between the sub-porphyritic formation (1,) and the range (2,) on the S. E., and the Calciferous formation (H,) on the N. W., and is terminated on the N. E. by a sub-porphyritic and porphyritic formation (4,) in Wilton, similar to that in Greenwich (1.) The characteristic Micaceous rock of the present range (3) has already been noticed. It has generally a dark or black ground, with peculiar light silvery shades or reflections. Occasionally, particularly on its S. E. border, adjoining (1,) it has a dark bluish somewhat plumbaginous tint, and a more talcose aspect, and is then generally associated with red felspar. The granitic rock of the range is generally white felspathic, with a structure more or less distinctly veined por-

phyritic; this peculiarity becoming more striking, as it approaches the Calciferous formation (H) on the N. W. Along the S. E. border of the range, adjoining (1,) large beds of coarse reddish Granite frequently occur, forming indeed in some parts a continuous range, and accompanied with the bluish sub-talcose micaceous rock, just referred to. The Granite itself also includes talcose seams, sometimes very decomposible. The rocks here resemble those along the West border of (2,) already noticed. Asbestos Hornblende occurs in this part of the range, in Stanwich. The granitic rock is most abundant in the central part of the present range (3;) the micaceous rock, on its borders. Thus a range of white or light grey Granitic rock may be traced from Byram river, through North Greenwich, Stanwich, and the village of Long Ridge, in the N. W. part of Stamford, in which very few Micaceous alternations are observable. In the same direction, East of Mill river (Stamford,) and North of the valley, extending N. E. from North Stamford, already noticed, an apparently isolated range, composed almost entirely of a white felspathic rock (Granitic Gneiss,) with very slight micaceous alternations, bears N. E. into Ridgefield, terminating near the North end of that village. The rock resembles that of the range, farther S. W., and like that, becomes more porphyritic, in its structure, as it approaches the Calciferous formation (H,) on the West. It adjoins this latter formation immediately on the West; its Western boundary extending along the East side of the Limestone valley of Mill river, in Poundridge and South Salem (N. Y.,) while on the North, it adjoins the same Limestone valley, as it bears Eastward, through Ridgefield, into the N. W. corner of Reading. Occasional beds of Hornblende, generally a very dark, even, uniform schist, occur in the present range (3,) particularly in its S. W. part, in North Greenwich.

4. Under this head, is included a range of considerable extent, in Wilton, extending N. into Ridgefield and Reading, and East, into the N. W. corner of Weston. It consists chiefly of a dark sub-porphyritic, more rarely porphyritic, rock, similar to

that of Greenwich (1,) and like that, generally more or less sub-hornblendic. It includes subordinate beds, usually small, of a white Granitic rock, adjoining which the Micaceous rock is generally less sub-porphyritic. It is divided, nearly through its middle, by a range of a different character (β,) passing, (near its southern termination,) through Wilton village, and thence extending North, along the valley of Norwalk river, into Reading. This range, at its S. point, consists of a rather coarse-grained Granitic rock, with red and white Felspar, greenish Talco-Chloritic seams, and veins of a bluish Quartz, with pyrites. It is arranged in large granite-like beds, but is distinctly parallel in its structure, and with slight micaceous or sub-hornblendic alternations, also pyritiferous. Generally it breaks in large or small jointed fragments. N. of Wilton village, and West of the Granitic range, just noticed, commences a high ridge of a dark grey, silvery shaded, rather coarse-grained Micaceous rock, with garnets (sometimes very large.) This micaceous range contains, at its S. point, a large interposed bed of Asbestos Hornblende rock, in which the asbestiform Hornblende is more or less blended with Talc, and farther N. a rather thin bed of a nearly white, very soft Talcose Slate, used (by Mr. Godfrey) in the manufacture of stone paint. Large beds of very coarse white Granite accompany this micaceous range, particularly towards the North. In one of these is situated the old excavation, on the East side of Norwalk river, in the N. part of Wilton, known as the Silver Mine, in the rubbish of which is found Galena and Copper Pyrites. This micaceous range is continued North into the formation (5,) next to be described. The peculiar sub-porphyritic rock of (4) is thus divided into two sections, which might even be considered as distinct formations. That on the West (α,) more uniformly resembles that of Greenwich (1,) and is usually distinctly sub-hornblendic, particularly along its Eastern border, adjoining the valley of Norwalk river, where it contains subordinate beds of Hornblende and green Pyroxene. Its thicker beds are there distinctly porphyritic, with white felspar, in a very dark ground,

presenting a striking contrast on their weathered surface. Farther N. it crosses the valley of the stream, last mentioned, and near the S. W. corner of Reading, includes a locality of Magnetic Iron, consisting of small veins or seams in a bed of Quartz. It extends still farther up the valley of Norwalk river, occupying a ridge West of the same, and East of the Granitic range of Ridgefield, along which it is continued nearly to the Eastern border of the Calciferous formation (H.) The Eastern section (γ) consists partly of a similar dark sub-porphyritic sub-hornblendic rock, particularly along its Eastern border, and partly of a lighter grey, more veined sub-porphyritic variety, somewhat resembling the veined sub-porphyritic rock (β) of the preceding formation (E,) with alternations of a dark blue Micaceous rock, similar to that of class 1st (F,) extending particularly along the East side of the middle Micaceous range (β,) above noticed. Along the Eastern border of this Eastern section extends a long range of the dark blue Micaceous rock of class 1st, more or less accompanied with Granitic alternations. This range, which properly belongs to the division (F2,) occupies a rocky ridge along the West side of the Saugatuck, whence it extends N. Easterly across that stream and the Aspetuck, into the S. E. part of Reading. The Granitic range of the Devil's Den, already noticed, extends along the West border of this latter range, and is situated nearly in the line of the East section (γ) of (4,) in a N. E. direction. It consists, like the Granitic range of Ridgefield, almost entirely of a white felspathic (granitic) rock, with but few Micaceous alternations. It contains, however, subordinate beds of Hornblende, one of which, East of the Saugatuck, consists of a very pure, large prismatic, sonorous Hornblende rock, taken for Iron ore, included in a very decomposible, dark micaceous, subhornblendic rock.

5. Under this head, is included a range of dark grey, silvery shaded Micaceous rock, similar to that of the range (3,) farther S. W., but with some peculiar characters. It is obviously, however, a continuation of the rocks of the 3d class (F,) towards

the N. E. The middle Micaceous range (β) of (4) is continued along the S. E. border of the present range (5,) adjoining the Granitic range, last noticed, at least to the Aspetuck, N. of Reading Church, and throughout presents more the usual characters of Mica Slate, than the rock of other parts of the range (5.) It sometimes contains very large garnets, and is generally accompanied, more or less, with beds of very coarse Granite. Along the Western border of this Micaceous range (β,) extends a narrow range of dark sub-porphyritic sub-hornblendic rock (δ,) apparently continued from the Western section (α) of (4) into the Porphyritic range of Newtown (6β;) but its continuity throughout I have not yet determined. The rock, in this sub-porphyritic range, is similar to that on the Eastern border of the Western section of (4,) and like it abounds in Hornblende. West of this, the prevailing rock (ϵ) is a more or less contorted, dark grey, bright silvery shaded Micaceous schist, with a peculiar talcose aspect, and often with garnets. Occasionally very ferruginous beds occur, generally with a peculiar bluish tint, and with traces of plumbago. Ferruginous beds of a similar character, also occur in the range (3.) Large beds of white Granitic rock extend through the middle of this Western section (ϵ) of (5,) partly very suitable for quarrying, and including Judson's well known quarry in the West part of Newtown. Smaller Granitic beds also occur in the more lateral portions of the same division of (5,) but these are quite subordinate to the including Micaceous rocks, while the Granitic rock in the middle portion, above noticed, generally predominates. This Western section (5ϵ) extends from near the S. W. corner of Reading, in a N. Easterly direction, through the N. part of that town, and along the high ridge, W. of Newtown village, to the Southern border of the Micaceous (Mica Slate) formation (G) of Litchfield County. Adjoining its S. W. extremity, on the N. W., between the Saugatuck and Norwalk rivers, is a circumscribed formation (ζ) of a light grey Granitic rock (gneiss,) perhaps connected with that traversing the range (5ϵ,) just noticed, and forming a connecting link between it

and the Granitic range of Ridgefield, at the N. E. termination of (3.) It is generally distinctly parallel in its structure, but with very slight Micaceous alternations, and is partly remarkable for its very regular prismatic cleavages. It is also occasionally very suitable for quarrying, and includes the quarry of Topstone Hill (Reading,) where it is quarried chiefly by means of its natural cleavages. This isolated Granitic range (ζ) is bounded on the S. W. by the Northern point of the Western section (α) of the sub-porphyritic range (4,) and on the N. by the Calciferous formation (H.) Along the Western border of the range (5,) between Reading and Bethel, and adjoining the Calciferous formation (H,) is a line of porphyritic rocks, which will be noticed under the latter.

(6.) Under this head, is included an extensive series of porphyritic and sub-porphyritic rocks, extending transversely nearly across the entire width of the present leading range (F,) chiefly in the towns of Newtown and Monroe. It there composes a large and well marked formation, strikingly characterized by its porphyritic structure. I have already observed, that several narrow sub-porphyritic (occasionally porphyritic) ranges, subordinate to the micaceous formation (2,) on the N. E., extend, in that direction, into, and coalesce with the present formation (6,) on the East, and that the sub-porphyritic band (δ,) traversing the range (5,) apparently also terminates in the present formation (6,) on the West. The long subordinate range of the blue Micaceous rock of (2,) already noticed as extending into the Eastern part of Reading, would, if continued, extend through the middle of the present formation (6.) In the Eastern part of this formation, in the N. E. part of Weston, and in Monroe, a white or bluish porphyritic Felspar predominates; in the Western part, in Newtown, a reddish porphyritic Felspar is most common. Exceptions, however, occur in both sections.

The Eastern section (α) first commences as a distinct formation, N. E. of North Fairfield village (Weston,) whence it extends through the Western part of Monroe, and the Eastern

part of Newtown (Zoar,) to the Housatonic, near Zoar Bridge, where it crosses that river in quite a narrow range, and is continued up the valley of Eight Mile river, at least to Quaker's Farms (Oxford.) On the East, this section passes into the porphyritic veined rock (β) of the preceding formation (E.) This line of junction passes West of Tashua Church, and along the Western base of the ridge at Monroe village. On the Western slope of that ridge, occurs a band of the coarse silvery blue Micaceous rock (αE,) nearly in the line of section (1) of that formation. The celebrated metalliferous Quartz vein of Lane's Mine (Monroe,) lies near the Western border of the porphyritic veined rock (βE.) The lime quarries, South of Quaker's Farms (Oxford,) are situated on the Eastern border of the Northern point of the present section, in a ridge extending along the West side of Eight Mile river, just N. of the Housatonic. Two distinct beds of Limestone are here observed, in the same range N. N. E., bordered by a dark subporphyritic rock, with included Porphyritic and Granitic beds, and a coarser blue micaceous veined rock; the latter somewhat resembling the Micaceous rock (αE.) Beds of Hornblende, sometimes with garnets, also accompany the Limestone.

The most characteristic rock of the present section (6 α,) is a large porphyritic, light grey, thick bedded, sub-granitic rock; generally with white felspar, and silver-grey mica; sometimes with sub-reddish or purple felspar, and darker greenish mica. This alternates with a darker grey sub-porphyritic rock, occasionally sub-hornblendic, particularly when associated with the reddish porphyritic variety. Subordinate beds of Hornblende sometimes occur; also beds of coarse white or reddish Granite. The Granite often has a distinctly porphyritic structure, even in the smaller veins. Beds of Granitic Gneiss are less frequent than in the range (2,) in the same line S. W. When they do occur, they are generally associated with a more micaceous, less sub-porphyritic rock, than that which accompanies the large porphyritic beds. In Weston, occurs a dark green sub-

chloritic, sub-hornblendic variety of sub-porphyritic rock, which may be traced, in a narrow range, by North Fairfield village, along the East side of the Aspetuck, to the plain at the junction of that stream with the Saugatuck, already noticed under (2.) In general, the greater portion of this Eastern section (6α,) in Weston, consists of dark sub-porphyritic rock; the large porphyritic prevailing only on its Eastern border. Farther N. E., the latter predominates throughout. In a line N. E. from the N. E. point of the Micaceous rock of (2,) in the Eastern part of Reading, already noticed, in high ridges, in the South part of Newtown, adjoining the valley of the Potatuck, both on the East and West, occur subordinate ranges of Felspathic (Granitic) rock, accompanied by a dark silvery micaceous porphyritic veined rock, somewhat resembling that between Huntington and Monroe (Eβ 13,) and bordered, both East and West, by a large porphyritic rock, generally with white felspar. These are apparently in the line between the Eastern and Western sections of the present range (6.)

The Western section (β) of this range commences, on the East, near the middle of the valley or basin of the Potatuck, between Newtown and Zoar, and extends West through Newtown, South of the village, till it apparently connects with the sub-porphyritic rocks (δ,) traversing the range (5,) already referred to, in a rocky ridge, in the S. W. corner of that town, called Bogus Woods. On the North, the rocks of this section adjoin the Micaceous (Mica Slate) formation (G,) at Sandy Hook village, and on the West, the continuation of the range (5ϵ,) West of Newtown village. Perhaps a branch of this section, in the valley opening N. W. from the source of the Aspetuck, to the valley of Still river, N. E. of Bethel, passes between the range (5ϵ,) in Reading, and its continuation, West of Newtown, and connects with the S. W. termination of the porphyritic formation (7.) The characteristic rock of this section is a thick bedded porphyritic rock, with large porphyritic points of red or purple felspar, in a dark greenish micaceous subchloritic ground, more or less sub-hornblendic, alternating with a dark sub-porphyritic, sub-hornblendic rock, generally quite

decomposible, and readily breaking in jointed fragments. Beds of Hornblende, generally sub-porphyritic, occasionally occur in this section, particularly where it adjoins the Micaceous formation (G,) on the North, and in the Bogus Woods, on the S. W. Patches of compact green Chlorite, accompanied with Magnetic Iron, also occur in this section, particularly on its Western border, where it joins the continuation of (5 ε.)

7. Under this head, is included a formation of dark sub-porphyritic, or small porphyritic rock, very similar to those of Greenwich and Wilton (1 and 4,) apparently commencing in the basin of the S. E. branch of Still river, N. E. of Bethel, and extending North, along the Western border of the continuation of (5 ε,) and farther North, along that of the Micaceous formation (G,) through Brookfield, and across the Housatonic, to a point between New Milford and Bridgewater. This formation, as already stated, resembles the sub-porphyritic ranges of Greenwich and Wilton (1—4,) in the line of which it is situated, rather than the porphyritic ranges of Newtown and Monroe (6.) Beds of a coarse and fine-grained red felspathic (granitic) rock occur, however, within its limits, particularly in the vicinity of Brookfield village. The characteristic rock of this formation is very dark (black) micaceous, more or less sub-hornblendic, generally white felspathic, often very decomposible, and at times cleaving concentrically, as in the Greenwich formation (1.) Beds of sub-porphyritic Hornblende occur, and also patches or nests of compact green chlorite, as in the porphyritic range of Newtown (6 β.) Where this range adjoins the Micaceous formation (G,) S. E. of Brookfield, there occurs an interposed band of a dark grey silvery shaded micaceous rock, abounding in small veins of coarse granite, and resembling the peculiar micaceous rock of (5 ε,) but coarser-grained, more contorted, and less fissile. At its N. point, the present formation runs out between the main body of the Micaceous formation (G,) and a process from the same, crossing the Housatonic, at the Falls (New Milford,) and extending some distance S. along the East side of the Limestone valley of Still river.

The arrangement of this formation (7,) at its Southern

extremity, I have not satisfactorily determined. It is traversed by the Housatonic Rail Road, from a point not far W. of the tunnel, N. of Newtown, nearly to the Eastern border of the Calciferous formation (H,) in the valley of Still river. South of the Rail Road, a band or range (β,) of considerable width, is interposed between it and the limestone valley of Still river, characterized by a peculiar dark grey sub-talcose micaceous rock, generally fine grained, and thinly fissile, and breaking into small jointed fragments. Nests of compact chlorite occur in it, as well as in the porphyritic formation (7.) Near the middle of the range, occurs a remarkable series of detached beds or veins of pure white or limpid quartz; the different beds interposed nearly directly between the strata, but the entire series crossing them obliquely N. W. in a manner similar to the arrangement of Granite beds, included between the strata of the rocks, in which they are contained. The micaceous rock of this range is remarkable for its toughness, a character observed also in other sub-talcose ranges. It includes subordinate beds of a coarse, tortuous veined, dark silvery shaded micaceous rock, analogous to that of (5 ϵ,) and also other beds of a very hard, compactly fine-grained, light greenish sub-pyroxenic granitic rock, breaking in small flat jointed fragments.

8. Under this head, is included nearly all that portion of (F,) N. E. of the Porphyritic ranges of Monroe and Newtown (6 α—β.) Within the space, thus included, there is indeed no little diversity in the character of the rocks, occupying it, but the whole are so combined, as to present satisfactorily the characteristics of a formation. The predominant rocks of this range are analogous to those of the third class of (F,) farther S. W., and indeed this whole section may be regarded as a continuation of the series (3—5 F,) separated by the interposition of the Newtown porphyritic range (6 β.) Rocks, however, analogous to those of class second of (F,) or to the porphyritic veined rock (β E,) and less frequently, others analogous to the micaceous rock (α E,) the latter sometimes with imbedded

through a valley opening towards Norwalk Borough (that of the Newtown Turnpike,) where it is accompanied with a light green Pyroxenic rock, with traces of Limestone. N. E. from this plain, within the limits of (F,) East of the Saugatuck, the rocks of the 1st and 2d classes are much intermingled, in apparently alternate ranges; those of the 1st class diminishing, and those of the 2d class enlarging into the extensive Porphyritic formation (6,) in Monroe. In these ranges of the 2d class, large porphyritic rocks occur, similar to those of the main formation in Monroe.

Subordinate beds of Hornblende, both uniform and thinly schistose, and sub-porphyritic (Sienitic,) occur at different points, in the Micaceous and Granitic rocks of the range (2;) generally associated with a darker, more ferruginous variety of Micaceous rock, sometimes greenish and sub-chloritic. The particular direction of the present range (2) will be better explained, after having completed the details of the entire range (F.)

3. Under this head I include the rocks of the 3d class, extending from New York State, through the Northern part of Greenwich, Stamford and New Canaan, into the limits of Wilton and Ridgefield. The line of the State, along the N. border of the three first of these towns, passes through this range, for the greater part of its distance. This range (3) is interposed between the sub-porphyritic formation (1,) and the range (2,) on the S. E., and the Calciferous formation (H,) on the N. W., and is terminated on the N. E. by a sub-porphyritic and porphyritic formation (4,) in Wilton, similar to that in Greenwich (1.) The characteristic Micaceous rock of the present range (3) has already been noticed. It has generally a dark or black ground, with peculiar light silvery shades or reflections. Occasionally, particularly on its S. E. border, adjoining (1,) it has a dark bluish somewhat plumbaginous tint, and a more talcose aspect, and is then generally associated with red felspar. The granitic rock of the range is generally white felspathic, with a structure more or less distinctly veined por-

phyritic; this peculiarity becoming more striking, as it approaches the Calciferous formation (H) on the N. W. Along the S. E. border of the range, adjoining (1,) large beds of coarse reddish Granite frequently occur, forming indeed in some parts a continuous range, and accompanied with the bluish sub-talcose micaceous rock, just referred to. The Granite itself also includes talcose seams, sometimes very decomposible. The rocks here resemble those along the West border of (2,) already noticed. Asbestos Hornblende occurs in this part of the range, in Stanwich. The granitic rock is most abundant in the central part of the present range (3;) the micaceous rock, on its borders. Thus a range of white or light grey Granitic rock may be traced from Byram river, through North Greenwich, Stanwich, and the village of Long Ridge, in the N. W. part of Stamford, in which very few Micaceous alternations are observable. In the same direction, East of Mill river (Stamford,) and North of the valley, extending N. E. from North Stamford, already noticed, an apparently isolated range, composed almost entirely of a white felspathic rock (Granitic Gneiss,) with very slight micaceous alternations, bears N. E. into Ridgefield, terminating near the North end of that village. The rock resembles that of the range, farther S. W., and like that, becomes more porphyritic, in its structure, as it approaches the Calciferous formation (H,) on the West. It adjoins this latter formation immediately on the West; its Western boundary extending along the East side of the Limestone valley of Mill river, in Poundridge and South Salem (N. Y.,) while on the North, it adjoins the same Limestone valley, as it bears Eastward, through Ridgefield, into the N. W. corner of Reading. Occasional beds of Hornblende, generally a very dark, even, uniform schist, occur in the present range (3,) particularly in its S. W. part, in North Greenwich.

4. Under this head, is included a range of considerable extent, in Wilton, extending N. into Ridgefield and Reading, and East, into the N. W. corner of Weston. It consists chiefly of a dark sub-porphyritic, more rarely porphyritic, rock, similar to

Housatonic, Northward to the S. point of the Secondary basin. At the N. W. angle of the Secondary basin, in the same relative position to (G,) occurs a small range (β) of Granitic rock, partly white felspathic, and resembling the preceding, but more generally, light grey, and sub-porphyritic in its structure. East of the range (α,) and S. E. of Southbury village, extends a narrow range (γ) of a coarse-grained bluish silvery Micaceous rock, with garnets, and occasionally with Kyanites, very similar to the peculiar Micaceous rock (α) of (E.) Along the N. side of the Secondary basin, occurs a small range (δ,) in which beds of a similar Micaceous rock are associated with large porphyritic, and dark veined sub-porphyritic rocks, the whole accompanied, particularly in its Eastern portion, with veins and beds of coarse White Granite, passing into a peculiar Granitic formation, adjoining it on the North, connected with the formation (G.) The rocks of the present range (9) recall distinctly those of the formation (E,) with its Granitic appendage in Huntington (10E,) and the porphyritic rocks of (10D,) adjoining the latter. This connexion will appear more obvious, when I have traced the continuation of the Micaceous rock (αE,) already referred to, around the Northern border of (8F.)

In viewing the entire range (F) as a whole, the rocks of the first class present no little analogy, in their characteristics, to the Micaceous rocks of the preceding formation (αE,) while the porphyritic rocks, associated with them, might be considered as holding a relation to them, similar to that of the porphyritic veined rocks (βE) to the latter. Thus considered, the rocks of the first class present the same recession of the Western Primary System, toward the West, along the line of the coast, which has already been noticed in the Chloritic formation (A,) and more particularly in the S. Western extremity of the Porphyritic formation (D.) The rocks of this class are also interrupted by the Porphyritic formation of Monroe (6αF,) nearly opposite the point, where the Micaceous rocks of the preceding formation (αE) advance toward the East, from the

N. point of (1E,) N. of Greenfield, to the Granitic range of Huntington (10E;) while the porphyritic formation (6F) is nearly in the same transverse line with that section of (E) between Huntington and Monroe (13E,) nearly occupied by the porphyritic veined rocks (β) of that formation. In tracing the rocks of the third class, toward the N. East, the same advance to the East is observable, in nearly the same transverse line as that of the first class (2F) and the Micaceous rocks (αE) of the preceding formation, namely, from the Granitic range of Ridgefield to the Micaceous range (5F) in Reading; while their second advance to the East, in (8F,) around the N. point of the porphyritic range (6F,) and their third advance, in the N. E. part of (8F,) correspond with the similar advances of (αE) along the N. side of the Housatonic, and at Beacon Mountain. The rocks of the first class being considered as passing into the Micaceous rocks (αE,) the larger porphyritic formations of (F) will be found occupying the middle line of the entire series, with a corresponding advance toward the East, namely, from the Greenwich formation (1) to the Wilton formation (4,) and from that to the range in Newtown and Monroe (6.) The Western and Eastern sections of the latter might be regarded as holding a relation respectively to the Western and Eastern Micaceous ranges of (F,) namely, those of the third and first classes. The Western section is also more directly in the line of the two S. W. formations (1 and 4,) while the Eastern section is in the same line of bearing as the small subordinate porphyritic ranges, included in the rocks of the first class (2F,) namely, that at the junction of the Saugatuck and Aspetuck, nearly parallel to (4F,) and that in Darien, in a similar relation to (1F.) The sub-porphyritic range (7F) has a peculiar relation to the next formation (G,) which will be better explained, when that formation has been described.

G. *A Micaceous Formation* (Mica Slate.)

Under this head, is included an extensive range, situated in the general line of direction of (F,) and presenting, in the

character of its rocks, some analogies to those of that formation, but on the whole, clearly distinct from it, in that respect. I have already observed that the peculiar Micaceous rock (α) of the formation (E) expands at its N. E. termination, and extends West through the town of Wolcott. The Western border of this expansion of (α E) first bears N. W., and then turning more directly West, nearly S. of the centre of that town, extends in that direction, across the Naugatuck, nearly to Watertown village, where it approaches the S. E. border of a Granitic range, already noticed as connected with the present formation (G.) The Micaceous rock (Mica Slate,) most peculiar to this formation, adjoins that Granitic range on the West, whence it extends South along the Western border of the Granitic Gneiss range (9β F,) the Secondary basin of Woodbury and Southbury, and the Granitic Gneiss range (9α F,) across the Housatonic, to the Northern border of the Newtown porphyritic range (6β F.) Its outlines on the S., adjoining the latter range, the Micaceous range (5ϵ F,) and the sub-porphyritic range (7 F,) have already been noticed. On the West, the present formation is first bordered by the Limestone valley of New Milford and New Preston, connected with the Calciferous formation (H,) and farther North, by a range of dark Micaceous ferruginous rock (I,) to be hereafter described. This Western boundary pursues a very undulating course, N. Easterly, through Litchfield, Torrington and New Hartford, and then bears Northerly, along the East side of the East branch of Farmington river, through Barkhamsted and Hartland, into Granville, (Mass.) The larger Secondary formation forms the Eastern boundary of the present formation (G,) from the N. E. point of (D,) Northward into Massachusetts.

The entire range of (G) is thus formed by the union of the Micaceous rock (α) of (E,) continued N. and N. W. from the N. E. point of the latter formation, and the Micaceous (Mica Slate) range, commencing in Newtown, while between them the Granitic range, West of Watertown, is at first interposed. It has been already observed, that the Micaceous rock of (E)

is somewhat analogous to that of the first (S. E.) class of (F.) The Mica Slate of the Western section of the present formation (G) is also, in some respects, analogous to the Micaceous rock of the third (N. W.) class of (F.) The Granitic range of Watertown is apparently the commencement of a series of large beds of coarse white Granite, traversing the formation farther north, while a series of isolated formations or basins, in which a Granitic (Felspathic) Gneiss predominates, extends along the East side of the formation, apparently in the line of (8F,) and connected with Micaceous rocks, similar to that of (E.) The entire formation (G) may thus be regarded as composed of two parallel ranges, embracing the Northern termination of the range (F,) while the latter is continued in the series of Granitic basins, included within the limits of (G,) just referred to. Having offered these preliminary remarks, I proceed to a more particular account of the subordinate parts of the present formation.

1. This section includes the country between the formation (F 8,) on the South, and a basin or isolated range of granitic gneiss, in Bristol, one of those already referred to, on the North. The prevailing rock, in this section, is nearly the same as that of (E,) namely, a coarse silvery Micaceous rock (Mica Slate,) generally less bluish, and rather less sub-porphyritic and veined with felspar. Beds of a finer grain, and more quartzose in composition, occasionally occur, as well as in the micaceous rock of (E.) Like that it abounds in garnets, and in some parts, with staurotides. A peculiar variety of the latter, consisting of small strongly bevelled crystals, is found in it, S. E. of Plymouth. The same variety is also found in (E,) at the passage of the Naugatuck through the range of Beacon mountain, thus furnishing an additional proof of the connexion of the latter formation with the present section of (G.) Beds or veins of coarse White Granite, and veins of white and limpid Quartz, also occur in this section, similar to those in the micaceous rock of (E.) This section is bordered on the South, towards (F 8,) by a narrow band of dark mica-seamed, sub-porphyritic

veined rock, (often with garnets,) with occasional beds of Hornblende, both garnetiferous and sub-porphyritic (Sienitic,) and near the Naugatuck, on the East, with beds of a light greenish Pyroxenic rock, and of a light grey Quartz rock, the latter breaking in small prismatic fragments. These frontier rocks are the same with those adjoining the formation (E) on the West (βE.) Along the Western (N. W.) border of this section, there also extends a range of porphyritic veined rock, like the former, at least from Watertown village, where it adjoins the granitic range, already noticed, to a point S. of Plymouth, and East of the Naugatuck. This latter range is accompanied, on its Northern border, with a narrow range of white Felspathic (granitic) rock, of nearly equal extent towards the N. E.; perhaps a continuation of the Granitic range of Watertown, extending towards the Granitic range of Bristol. Beds of white Limestone, generally of no great extent, occur in connexion with the range of porphyritic veined rock, last noticed, in Watertown and Plymouth, both East and West of the Naugatuck. They have been quarried, in three or four localities, both for lime and marble. They are analogous, in situation and character, to the limestone beds, accompanying the formation (E,) already noticed. The Limestone, in these beds, is usually much involved with beds of white felspathic granite, and dark, generally uniform Hornblende. Beds of a similar Hornblende accompany the Granitic range, parallel on the North.

2. The Granitic range, West of Watertown. This is apparently almost entirely composed of a coarser and finer-grained, very felspathic Granite, usually with white, but sometimes with reddish felspar. This Granite is generally very decomposible, and often breaks into small prismatic fragments. Usually its structure is distinctly parallel, and veined porphyritic, giving it, when finer-grained, a mosaic aspect, similar to that of the Granitic rock, accompanying the formation (C.) Sometimes it includes masses of fine graphic granite, and large and delicate specimens of plumose mica are occasionally found in

it. In traversing this range, very little rock is seen but the granite, and this rarely in unbroken ledges on the surface; but dark silvery shaded micaceous alternations occasionally occur, as if interposed between the granitic beds. This range, on the S. W., adjoins the granitic and sub-porphyritic rocks of (β–δ 9 F,) and the Mica Slate of the present formation, farther West, (G 3,) and apparently terminates in smaller beds or veins of Granite, included in those rocks. Where it adjoins the Mica Slate (G 3,) on Sprane river, N. W. of (β 9 F,) there occurs a series of beds of a coarse reddish Granite, in a dark silvery shaded Mica Slate, apparently nearly transverse to the latter, but arranged with too great regularity to have been the result of accidental intrusion. Near its Southern termination, on the East, a band of a dark porphyritic veined rock, similar to that bordering the preceding section (1,) on the South and West, is interposed between the present range and the peculiar Micaceous rock of (F 8;) perhaps continuous with the same rock, already noticed, at Watertown village, and thus connecting the rocks of (δ 9 F,) with those of section (1,) to which they are analogous. On the N. E. this Granitic range crosses the Litchfield Turnpike, North of Watertown village, but its precise termination, in that direction, I have not ascertained. Its connexion with the Granitic rock S. of Plymouth, and with the beds of coarse Granite, traversing the present formation (G,) farther N. E., has already been suggested.

3. Under this head, I include all that part of the present formation (G,) West of (2,) from its Southern termination, in Newtown, to the Naugatuck. This section includes several subordinate ranges, which can be distinctly traced through a great part of its extent, and some of them much farther towards the N. E. I have, therefore, limited it, in that direction, by the Naugatuck, not because it there properly terminates, for it may be continued still farther along the West side of the formation, but for convenience in description. The more extended ranges, in this section, follow the general direction of the formation itself, as indicated by its Western boundary, already pointed

out; namely, first bearing West of North, from the S. E. point of the formation, in Newtown; then bending N. E. (in some points nearly East,) round the Northern border of the Granitic range (2,) and again bearing more N. Easterly, towards the Naugatuck. But in the vicinity of that river, particularly on the Western, or rather Northern border of the formation, there is great irregularity in the direction, which is sometimes even S. Easterly; the rocks of the present formation there bending round the S. point of the Micaceous formation (I 2,) as will be afterwards explained.

The subordinate parts of this section may be now more particularly noticed. (α.) At its S. Eastern termination, on both sides of the Housatonic, the prevailing rock is a light silvery grey Mica Slate, with greenish shades or patches, somewhat resembling the rock of (C1.) Like that too, it is accompanied, particularly on the S. W., by large subordinate ranges or beds of dark and light green Hornblende, both schistose and sienitic. The largest of these ranges is S. of the Housatonic, in the N. W. part of Newtown. On the Southern border of this sub-division, at Sandy Hook, occurs a very dark (nearly black) plumbaginous variety of Mica Slate, breaking in conchoidal fragments, like a similar variety on the Western border of (C,) and generally very contorted and pyritiferous. This rock has been recently excavated, at great expense, in a fruitless search for anthracite coal. It is traversed by a Quartz vein, containing traces of galena, with iron pyrites. Subordinate beds occur, in this part of the present section, of a dark grey, very coarse-grained, thick bedded and contorted Micaceous rock, abounding in Kyanites, sometimes large, and grouped in divergent clusters. The Mica Slate of the present division extends South, towards the continuation of (5 F,)W. of Newtown, in a narrow band, crossing the line of the Housatonic Rail Road, at the tunnel, N. of that village. The precise point of its termination in that direction, I have not yet ascertained.

(β.) A range, characterized by a rather coarse flaky or plated, dark silvery shaded Mica Slate, extends along the Eastern bor-

der of the present section, from the N. part of Southbury, adjoining the Secondary basin on the West, nearly or quite to the Naugatuck in Plymouth. It abounds in small veins of limpid Quartz, which sometimes contain seams of Crichtonite (W. of Woodbury and in Plymouth.) In that part of this range, N. and N. E. of the Granitic range (2,) (in Northfield and Plymouth,) beds of coarse white Granite are very frequent, sometimes forming long continuous ranges, in the general direction of the including Mica Slate.

(γ.) In the S. W. part of this section, West of the Shepaug, is a range of considerable extent, chiefly composed of a white felspathic Granitic Gneiss, more or less seamed with white mica, and proportionally more or less fissile, with comparatively rare alternations of a dark silvery Micaceous schist; the whole very similar to the rocks of (α 9 F.) The granitic gneiss of this range is often valuable for quarrying, but its structure is too parallel to answer well the purposes of granite in building. This range includes the well known ridge of Mine Hill (New Milford,) in which is situated the vein of Spathic Iron, formerly worked to a considerable extent as a silver mine.

(δ.) The central part of the present section (3,) embracing, in its Southern portion, at least partly, the range (γ,) is characterized by beds or subordinate ranges of a fine-grained, generally rather thick slaty, lighter or darker blue, quartzy, subcalcareous Micaceous rock, which in Washington has been ground, as a material for agriculture. Its fertilizing property, if it possesses any, it probably derives from its lime, perhaps in combination with its iron pyrites. A small bed of impure limestone occurs in this part of the section, West of the Shepaug, on the road from Washington to New Milford. The fine-grained variety of Mica Slate, just noticed, is generally very ferruginous, particularly the darker blue, and at the same time very decomposible. It is accompanied with coarser-grained, more micaceous varieties, partly dark silvery shaded, and more fissile, and in part, chiefly composed of a nearly white mica, with a peculiar silky lustre, less fissile, and abounding in large

garnets. This central range of section (3) extends through Washington village, the Western part of Bethlem, and Litchfield South Farms, and then bearing N. Easterly, apparently curves round the village of Northfield to the Naugatuck S. W. of Harwinton. A range of Hornblende, partly of an uniform dark green, and thinly schistose, and partly thicker bedded and more or less sub-porphyritic (sienitic,) apparently traverses the greater part of this central range, commencing on the West of the Granitic range (γ,) and extending thence North-Easterly through Washington village, then bearing Easterly near the South line of Litchfield, and again N. Easterly between South Farms and Northfield. The direction of the rocks in the present section (3) is most distinctly marked by the fine-grained blue micaceous rock, above noticed, and the subordinate range of Hornblende, just referred to. It corresponds very distinctly with that of the Western boundary of the present formation (G,) already described.

(ε.) Along the Western border of the present formation (G,) extends a rather narrow range, characterized by a fine-grained, light grey, quartzy Mica Slate, generally quite even and fissile, and more resembling the peculiar Mica Slate of the Bolton quarries, than any I have observed in the Western Primary. Occasionally it passes into a thicker bedded, lighter grey Micaceous Quartz rock. It alternates with beds or layers of a coarser, more micaceous, dark silvery shaded variety, with garnets, and is accompanied, particularly on its immediate Western border, with large beds of a dark green, fissile Hornblende Slate, forming apparently an almost continuous range along the whole Western frontier of the present formation (G,) at least as far N. E. as the vicinity of Litchfield Pond. The present range (ε) terminates on the S. W., in the process, already noticed as crossing the Housatonic at the Falls (New Milford,) and as extending farther South, between the sub-porphyritic range (7 F,) and the Limestone valley of New Milford, in a line of direction towards the Talco-Micaceous range (F 7 β.) It extends N. Easterly, along the East side of that valley, to its

termination, and then Easterly, through the ridge of Mt. Tom (Litchfield,) to the S. W. point of Litchfield Pond. Rocks of a similar kind may be traced, farther N. E., by the S. side of Litchfield village, and along the ridge East of Bantam river, East of that village. These will be afterwards referred to, under the last division (η) of the present section (3.) Along the Eastern border of the range (ϵ,) particularly where it bears East, S. of the ridge of Mt. Tom, and of Litchfield Pond, beds occur of a dark blue, thinly schistose, sub-argillitic Mica Slate, generally decomposible and ferruginous. These are particularly abundant on the road leading West from South Farms village. They may perhaps be considered as more properly connected with the blue quartzose Mica Slate of the preceding range (δ.) An apparently limited range of sub-porphyritic (sienitic) Hornblende occurs in that part of the present section, S. E. of Mt. Tom; extending S. E. from Bantam river, at least to a conical summit, composed chiefly of this rock. This is of a dark green; partly very fine-grained, and slightly sub-porphyritic; partly coarse-grained, and veined porphyritic, with a greater predominance of felspar. The structure of the rock is throughout distinctly parallel. It generally breaks in large or small prismatic fragments.

(ζ.) Under this head, is included, as an appendage to the formation (G,) a remarkable isolated formation of dark sub-porphyritic and porphyritic rock, analogous to the sub-porphyritic formations (1—4—7 F,) and in the same general line of direction N. Easterly. It is situated in the Western part of Litchfield, and is surrounded on the S. and E., by the formation (G,) and the W. and N., by the Micaceous formation (I.) At its S. E. point, it adjoins Litchfield Pond, and at its S. W. point, Mt. Tom Pond; the ridge of Mt. Tom being included within the preceding range (G ϵ.) The predominant rock of this formation is a more thinly schistose, or thicker bedded, dark micaceous sub-hornblendic rock, sub-porphyritic or large porphyritic in structure, generally with purple felspar; the larger porphyritic points square-shaped, and with disseminated flakes

of black mica, like a variety already noticed in (10D,) Huntington. The large porphyritic rock, as in that instance also, is generally thick bedded, with a fine-grained, dark uniform ground, but occasionally lighter, coarser-grained, and more felspathic (granitic,) and is arranged, in the more schistose subporphyritic rock, nearly in the same manner as interposed beds of Granite. The dark sub-porphyritic rock, when more hornblendic, is often very decomposible, cleaving concentrically, as in (1, 4, 7F.) Beds of Hornblende, generally sienitic, not unfrequently occur, and near Bradleysville (Litchfield,) is one of a very pure, sonorous, dark Hornblende rock, like that of Weston, noticed under (4γF,) which, like that, has been worked as an iron ore. Very ferruginous pyritiferous beds occur, particularly one, from which a strong chalybeate spring issues, situated on the East side of Prospect Mt., an isolated summit in the N. W. part of the formation. Veins or beds of a very fine-grained, dark grey Trap-like rock, sometimes traverse the rocks of this formation, particularly on the N. E. declivity of Prospect Mt.; the only instance in which I have observed any rock, resembling Trap, beyond the limits of the four great dikes, already noticed. These veins are, however, rather a fine-grained Primary Hornblende, than a Trap; the structure being more parallel, than that of the latter, conformably with the general Primary structure. In a direction North from the N. E. point of this formation, on the West border of the formation (G,) there occurs a narrow range or bed of Serpentine, apparently connected with the present formation (ζ.) The connexion of Serpentine with the sub-porphyritic formation of Greenwich (1F,) has already been noticed.

(η.) Under this head, is included all the remaining portion of section (3,) commencing on the North of Litchfield Pond, and extending, in a curve, around Litchfield village, on the North, to the Naugatuck, S. of Wolcottville. In the S. W. part of Torrington, a process from the present formation (G,) extends N. to a point, terminating in a small appended Sienitic formation (δ,) to be afterwards noticed. The rocks of the pre-

sent division of section (3) appear, from the direction of the strata, to be rather directed towards a point at this termination, thus , than to form a graduated curve, thus . The predominant rock of the present division (η) is a coarse-grained, dark grey, silvery shaded, often tortuous veined Mica Slate, abounding in garnets and staurotides, and more rarely in kyanites. Near the Western border of its Northern termination, S. of the appended formation (θ,) is a small subordinate range, chiefly occupied by beds of Hornblende, with Epidotic nodules, and of a coarse veined Mica Slate, with kyanites, similar to that in Southbury, already noticed under the first division of the present section (α3G.) Near the middle of this Northern termination, is also a subordinate range of a fine-grained, even, thinly fissile Mica Slate, with beds of a dark green, thinly schistose Hornblende; apparently in the same range with the continuation of (ε,) in the ridge East of Litchfield village. In this latter ridge, large beds of a similar Hornblende rock occur, and also others, partly dark green, finely spicular and sub-micaceous, with included beds of a coarse veined porphyritic Sienitic variety, similar to that noticed under (ε,) and partly tortuous, with garnets. On the East side of that ridge, is a bed of sub-talcose asbestiform Hornblende, both thick bedded and thinly fissile; the latter variety approaching a Talcose Slate. The coarser grained varieties of the present division (η) predominate both East and West of this central band, namely, N. W. of Litchfield village, and West of the Naugatuck. The rocks there more nearly resemble those of the Micaceous formation (I,) to which they are adjacent, but are less felspathic and ferruginous.

(θ.) The small appended Sienitic (sub-porphyritic) formation, just noticed, commences S. W. of Torrington meeting-house, in a ridge S. of the Goshen Turnpike, and extends to a point N. of that meeting-house. The most characteristic rock of this formation is a thick bedded sub-porphyritic (Sienitic) Hornblende, (sometimes passing into a nearly uniform, massive Hornblende rock,) alternating with a dark sub-porphyritic sub-

hornblendic rock, a coarser grained, dark micaceous garnetiferous rock, and a very fine-grained, dark micaceous sub-hornblendic rock, with occasional beds of a silver grey Mica Slate, with garnets; the latter showing the relation of the whole to the formation (G.)* The rocks of the present formation (δ) are apparently sub-talcose or sub-chloritic. The Copper Mine of Torrington (Coe's) is situated in the southern part of it. It is in the general line of direction of the Porphyritic formation (ζ,) with which it has many resemblances in character. It is, however, still more Hornblendic, as that is more so than the sub-porphyritic formations, in the same general direction farther S. W., namely, (1—4—7 F.)

From the preceding statement, it will be perceived that the section (3,) as it approaches the Naugatuck, in its progress N. E., presents three parallel ranges, namely, an Eastern range (β,) characterized by a coarse, dark silvery shaded Mica Slate, abounding in beds of coarse white Granite; a middle range (δ,) characterized by its bands of blue ferruginous Mica Slate; and a Western range (η,) consisting chiefly of a coarse, dark silvery shaded Mica Slate, similar to that of the Eastern range.

Having thus completed a general survey of the present formation, S. W. of the Naugatuck, and S. of the Bristol granitic basin, (G S.,) I proceed to describe the more northern portion of it (G N.) In this, the more important ranges of the Southern part of the formation, are continued to a greater or less distance Northward. The coarse silvery Micaceous rock of (1 S.) forms a range, extending along its Eastern border, at least as far N. as Westfield river. This range includes, within its limits, a series of subordinate formations or basins of Granitic rock, generally bordered by the dark sub-porphyritic veined garnetiferous rock, accompanied with garnetiferous Hornblende, occupying the same relative position in connexion with (1G S.) and (E.) These basins will be noticed in their order. The

* A similar Mica Slate, with garnets, also occurs, in subordinate beds or ranges, in the Porphyritic formation (F 7,) S. of the Housatonic Rail Road. The sub-porphyritic rock of (ζ) also alternates with a similar Mica Slate, near the Southern border of that formation, where it adjoins the Mica Slate of (ε.)

coarse, dark silvery shaded Mica Slate of (3β S.,) after crossing the Naugatuck, and traversing the Northern part of Plymouth, and the S. Eastern part of Harwinton, apparently coalesces with the preceding, in the N. Western part of Burlington. The range (3 δ S.,) characterized by its fine-grained, blue, quartzy ferruginous Mica Slate, may be distinctly traced through the centre of the formation, at least to the Northern part of Canton. The coarse, dark silvery shaded Mica Slate of (3η S.) extends along the Western border of the formation, at least to Blandford (Mass.;) preserving distinctly, throughout this great extent, its peculiar characteristics, and generally accompanied with staurotides, and often with kyanites. The Northern part of the present formation (G N.) thus presents, towards the South, three distinct parallel ranges; namely, an Eastern range, formed by the union of (1 S.) and (3 β S.;) a middle range, formed by the continuation of (3 δ S.;) and a Western range, corresponding to (3η S.) Towards the North, where the middle range can be less distinctly traced, it may be considered as occupied by the Eastern and Western ranges. As these present, on the whole, a general resemblance in the character of their rocks, the entire formation, which is there of comparatively little width, might be regarded as forming at last only a single range. Conformably to this general arrangement, the Northern part of the present formation (G N.) will be considered under three leading divisions.

1. The Eastern range, formed by the continuation of (1) and (3β) of the Southern portion of the formation (G S.,) and including the series of Granitic basins, above alluded to. The Southern part of this division is less uniform, and may be described under different sections; but the Northern part presents a more uniform character, being chiefly composed of a coarse-grained, light silvery Mica Slate, generally less bluish than the corresponding rock, farther South. In this part of the range, the direction is also more uniform, nearly North and South.

In giving a more detailed view of this division, the Bristol

Granitic basin (α) will be first noticed. This occupies the greater part of that town, from its centre Westward, and extends into the Eastern part of Plymouth. The surface is generally covered with Diluvium, but the rock, where exposed, consists chiefly of a white or light grey Granitic Gneiss, with alternate beds (less frequent) of a darker silvery micaceous schist, generally very decomposible. The Granitic Gneiss itself is usually quite decomposible, but from the thickness of its beds and its softness, it may be often advantageously quarried for building. This basin is bordered, at least on the East and West, by a band of the dark sub-porphyritic veined garnetiferous rock, already noticed, with beds of Hornblende; partly darker and garnetiferous; partly lighter green and more schistose, and occasionally with nodules or patches of yellow-green Epidote. This last variety is particularly observable on its Eastern border. On the South, this basin is bounded by the Micaceous rock of Wolcott (G S. 1,) but the immediate junction of this latter rock with the peculiar rock of the basin is generally concealed by the Diluvium accumulated on the Northern declivity of Wolcott Mt. The Micaceous rock of (1 M. 1) ranges along the summit of this declivity, in a line nearly East and West, with a large inclination South, as if dipping from the Granitic Gneiss, on the North.

Along the Eastern border of the basin (α,) extends a very narrow range (β,) separating it from the Secondary, composed of the coarse silvery Micaceous rock of the present division (1,) partly darker blue and more plumbaginous, like the rock of (1 S.) Along the Western border of this range, extends a narrow bed of Magnesian rocks (Serpentine and Talc,) associated with Asbestos Hornblende, Limestone and green Pyroxene. This bed may be traced, at intervals, at least from the Pequatock, on the South, nearly two miles Northerly to Bartholomew's Factory. This range also includes large beds or veins of coarse Granite, partly with fine red felspar. The general inclination of the strata, in this range, is large East, as if directed from the Granitic basin on the West.

(γ.) Under this head, is included all that portion of the present range (1,) interposed between the Granitic basins of Bristol and Canton. This range, commencing at the N. E. point of the Bristol Granitic basin (α,) extends North, along the Western border of the Secondary, to Farmington river, where it meets the S. W. point of the Canton Granitic basin (ε.) It then extends still farther N. along the W. side of that river, which here generally separates it from the Canton basin, to a point not far North of Collinsville. On its Southern border, it extends West, around the Northern skirts of the Bristol Granitic basin (α,) till it meets the continuation of the dark silvery micaceous range (G S. 3 β,) near the S. W. corner of Burlington. The predominant rock, throughout this section, is the coarse silvery micaceous rock of the present range, less bluish than that of the formation (E,) and more nearly allied to that of (G S. 1 ;) generally accompanied with garnets, and more rarely with staurotides. Occasionally beds occur of a finer grained, more even and fissile schist, either lighter grey and more quartzose, or darker grey, sub-felspathic and gneissoid. This latter gneissoid variety occurs at its S. E. point, at the Bristol copper mine, and may be traced still farther N. along the W. border of the Secondary and the Canton Granitic basin (ε.) The Bristol Mine is chiefly opened in a large vein of a coarse reddish sub-talcose Granite, adjoining which the gneissoid micaceous rock, just referred to, is also sub-talcose or sub-chloritic, with decomposed greenish chloritic seams and nodules, and with more or less copper disseminated. Similar Granitic veins, with traces of copper, occur in the gneissoid rock, as it extends farther North, at least as far N. as the vicinity of Collinsville. Beds or veins of coarse white Granite are not unfrequent throughout this section. They are particularly abundant in a high ridge, on its Western border, extending through the S. W. part of Burlington, where they form an almost uninterrupted range. North of the Bristol Granitic basin, a high ridge, with a nearly uniform tabular summit, extends East and West, separating that basin

from a smaller one on the North, near the centre of Burlington, but in which I have observed no satisfactory indications of a Granitic formation. On the N. Eastern border of the present section (γ,) where it adjoins the Canton Granitic basin (ε,) it is bordered by the dark sub-porphyritic veined rock, already noticed, with its usual accompaniments; and subordinate ranges of the same rock, occur in that part of the section, more remote from the border of the Granitic basin.

(δ.) Under this head, is included the section between the Bristol Granitic basin, on the East, and the Naugatuck; extending N. Easterly, till it unites with the preceding section, as already indicated. This is apparently a continuation of the range (G S. 3β,) and like that, is composed of a coarse, dark silvery shaded Mica Slate, gradually assimilating in character with the lighter silvery Mica Slate of the preceding section. It generally abounds in large beds of a very coarse white and more rarely reddish felspathic Granite, which in some parts of the section rather predominate.

(ε.) The Canton Granitic basin. This, although separated from the Bristol Granitic basin, by a wide interposed band of the Mica Slate of (γ,) closely resembles it, both in the character of its rocks, and in its relations to the Micaceous rocks inclosing it. It commences, on the S. W., at a point, on the East side of Farmington river, just above Perry's Bridge, whence its Western border extends N. along the course of that river, to a point not far above Collinsville, and then curves around the village of South Canton, at the distance of about a mile on the North, till it meets the Secondary, about the same distance N. E. from that village. It is inclosed, throughout this entire circuit, by the Mica Slate of the present range (1,) which obviously dips from it, in the same manner as along the borders of the Bristol Granitic basin, generally at a large angle; its dip thus varying from S. W. at its Southern, to E. N. E. at its N. Eastern termination. At the latter point, a narrow process of the Mica Slate of (1) runs down a short distance between the peculiar porphyritic veined frontier rocks of these basins, and a Trap ridge,

connected with the Secondary. Along the remainder of its Eastern border, the rocks of this basin immediately adjoin the Secondary. The predominant rock of this basin is a light grey, generally even Granitic Gneiss, often with garnets, alternating with a darker grey, more micaceous Gneiss, with which last are often associated beds of a dark uniform Hornblende. The rocks of this basin, particularly the darker grey micaceous and Hornblendic rocks, are, in some parts, traversed by frequent veins of coarse granite, often with red felspar. Along its border, towards the Mica Slate of (1,) there occurs an interposed band, similar to that adjoining the Bristol Granitic basin, composed of the porphyritic veined garnetiferous, and garnetiferous hornblendic rocks, already referred to, with which are associated veins of coarse Granite, and subordinate beds of Granitic and more micaceous Gneiss; the latter approaching the Mica Slate adjoining.

(ζ.) Under this head, is included all that portion of the Eastern range (1,) North of Farmington river, and of the Canton Granitic basin (ε.) Within this section, are included two subordinate Granitic basins, but of comparatively small extent, and with less distinctly marked outlines; namely, one (†,) near the S. Western, and another (‡,) in the N. Western corner of Granby; the latter extending into East Granville (Mass.) These consist chiefly of a white or light grey felspathic Gneiss, generally quite decomposible, with occasional micaceous alternations, usually still more decomposible and ferruginous. These two basins occupy remarkable isolated valleys, surrounded by ridges composed of the Mica Slate of the present range (1.) The peculiar porphyritic veined frontier rocks, I have not observed adjoining the first of these basins. They occur, however, along the Western declivity of a ridge, adjoining the Northern basin on the N. E., S. E. of East Granville village, where they also dip from the Granitic rock, Eastward. In the same ridge, rather more remote from the Granitic rock, and associated with the Mica Slate of (1,) is a small bed of a light green pyroxenic rock, similar to that on the S. frontier of (G S. 1,) East of the Naugatuck.

The Mica Slate of this section is generally coarse-grained, and of a light silvery grey, with little of the peculiar bluish tint of the formation (E,) and is generally accompanied with garnets, and more rarely with staurotides. Large interposed beds or veins of coarse white Granite are frequent, and also subordinate beds of a fine-grained, generally even, white felspathic Gneiss, similar to that of the included basins, already referred to. In one instance, in a ridge adjoining the Granitic basin (†,) on the S. E., I observed, in the Mica Slate, a small bed of an impure white Limestone.

2. The Middle range, formed by the continuation of (3δ) of the Southern portion of the present formation (G S.,) may be traced distinctly in a band of no great width, diminishing towards the North, from the Naugatuck, N. E. of Northfield, through the centre of Harwinton, the S. E. part of New Hartford, and the Western part of Canton, nearly to the N. line of the latter town, S. W. of the Granitic basin (1†.) Farther North, slighter traces of its peculiar rocks may be observed, in the same direction, near the middle line of the entire formation (G.) This range is characterized by a fine-grained, darker or lighter blue Mica Slate; the darker blue generally quite ferruginous, and more micaceous; the lighter blue thicker, more quartzose, and occasionally marked with transverse flakes of mica. This latter variety occurs particularly in the more Northern part of the present formation, and is generally very hard and indestructible. Diluvial blocks of it are not unfrequently observed, scattered over the Secondary, towards the S. S. E., nearly to the Southern termination of the latter. Towards the S. W., in Harwinton, where this range is of considerable width, it is often highly ferruginous, from the presence of pyrites, and is accompanied with large beds of a very coarse white Granite; the latter less frequent, however, than in the adjoining ranges, East and West.

3. The Western range, corresponding to (3η) of the Southern portion of the present formation (G S.,) may be traced along the Western border of the formation, from the Naugatuck, below Wolcottville, first in an undulating course North Easterly

through the N. W. part of Harwinton, the S. E. corner of Torrington, and the centre of New Hartford, to the valley of the East Branch of Farmington river, and then North along the E. side of the latter, into Massachusetts. Its Western border may be traced farther N. along the ridge East of West Granville village, and bearing rather N. W., along a line West of Blandford village. The Western border of this range, also that of the entire formation (G,) is frequently marked by a line of beds of Hornblende; generally dark green, uniform and thinly schistose; more rarely thicker bedded and garnetiferous. The rock, throughout this range, is generally a coarse-grained, dark silvery shaded, thinly schistose Mica Slate, occasionally thicker and more contorted; with garnets, frequently with staurotides, and particularly in the vicinity of Quartz veins, with kyanites; thus resembling, in its accompanying minerals, the rocks of the range (3 $\frac{1}{2}$ S.) N. E. of Litchfield. Occasionally beds occur of a fine-grained, even, more quartzose Mica Slate, also with garnets; well suited, by its grain, softness and thickness, for quarrying. Such a variety has been quarried to some extent, in the ridge East of the E. branch of Farmington river, S. E. of Barkhamsted. Beds of coarse white Granite are very frequent throughout the greater part of the range, even more so than in the corresponding part of the Eastern range (1.) This is particularly the case in the ridge along the E. side of the E. Branch of Farmington river, where they form an almost continuous series of high white ledges, ranging in the direction of the formation. Beds of Hornblendic Asbestos occur in the Eastern part of this range, S. East of New Hartford meeting-house, probably connected, in their range, with an analogous rock, noticed in the ridge East of Litchfield village.

The entire width of the present formation (G) is comparatively small, N. of the point where it bears N. along the E. side of the E. branch of Farmington river, and the whole may be there regarded as a single range, about equally composed of the Eastern and Western ranges (1—3) continued; the rocks throughout having a general resemblance, but darker on the

Western border, and with more of the bluish tint, peculiar to the formation (E,) on the Eastern border.

The present formation (G,) viewed as a whole, may be regarded as formed of two parallel ranges, Eastern and Western, corresponding respectively to the Eastern Micaceous range (First class) of (F,) continued in the formation (E,) and to the Western Micaceous range (Third class) of (F.) This correspondence may be traced, not only in the direction, but in the physical character of the rocks of these different ranges. Still the formation (F) is throughout characterized by a greater predominance of Felspar, than either (E,) which is obviously continued in the Eastern range of (G,) or the Western range of the latter. The Granitic basins, traversing the formation (G,) may be regarded as more direct continuations of the formation (F.) This, at its N. E. extremity, is inclosed between the formation (E,) on the East, and the Western range of (G,) on the West, while those basins form a series of isolated formations in the Eastern range of (G,) which expands from (E) around the N. E. point of (F,) continued Northerly in the same direction as the latter. The three great formations (E—F—G) may be thus considered as constituting a whole; extending through the State, from New York, on the S. W., into Massachusetts, in a wide band, parallel to the four preceding formations (A—B—C—D,) and like those, forming a distinct curve, presenting its convexity to the East. The general direction of this range is N. Easterly, till it meets the Secondary, N. of the Northern termination of (D,) and then Northerly along the Western border of the Secondary. It is worthy of remark, that its Western border, soon after entering Massachusetts, bears distinctly to the West.

(H.) *A Calciferous Micaceous Formation* (Gneiss.)

Under this head, I include all that part of the State lying West of the two preceding formations (F and G,) and S. of a line drawn West from the N. E. point of the New Preston Limestone valley, near the S. W. point of the isolated Porphy-

ritic formation (Gζ S.,) by the S. side of Romaug Pond, by the N. side of Kent Hollow, N. of the Kent ore bed, and by the valley of Dover river, where it enters the Housatonic, to the line of New York. Throughout this extent, the rocks present peculiar traits of resemblance, sufficient to mark them as members of a common formation, and are, at the same time, accompanied, in a much greater degree than any of the preceding formations, with subordinate beds and ranges of Limestone. Probably more than one half of the extent of this formation is included within the limits of New York; but from its general N. Easterly direction, nearly its entire width, at its Northern termination, lies within the limits of this State. Its Eastern and Northern boundaries have been already traced. Its Western boundary extends S. from the valley of Dover river, above referred to, along the Eastern border of the Dover Limestone valley, around the Southern termination of that valley, and then S. W. along the Eastern border of the Highlands, between Carmel and Somers (N. Y.) It thus includes the S. E. part of Putnam Co., and probably the greater part of Westchester Co. (N. Y.) The S. E. corner of the latter County, on the Sound, is occupied by the continuation of (F,) S. W. from Byram river.

The Eastern line of this formation enters this State near the Lime quarries in North Greenwich, whence it extends N. Easterly across the N. W. corner of Greenwich, and then in an E. N. E. direction, through Northcastle and Poundridge (N. Y.,) nearly parallel to the North line of Greenwich and Stamford, to the valley of Mill river, near the N. line of the latter town. It then extends nearly N. N. E. along the East side of the valley last mentioned, through South Salem (N. Y.,) adjoining the Granitic range of Ridgefield, on the West, and again bears E. N. E. through Ridgefield, around the N. point of the latter range, of the Porphyritic range (F 4,) and of the Granitic range of Topstone Hill (F 5ζ,) to the valley of the Saugatuck, in the N. W. part of Reading. From this point, it again extends N. N. E., by the E. side of the valley of Still river, through Danbury and Brookfield, to the Housatonic, at the Falls (New

Milford,) whence it is continued, in the same general direction, along the East side of the Limestone valley of New Milford and New Preston, to its Northern termination, less than a mile from the Shepaug, on the New Milford and Litchfield Turnpike. Near its termination, it again bears more to the East (about N. East.) Throughout the greater part of this distance, this Eastern border is marked by a remarkable Limestone valley (†,) which will be hereafter more particularly described.

The predominant rock of this formation is a dark or light grey, striped or veined Micaceous rock, characterized by its peculiar fine grain and soft lustre. This is associated with various other rocks of a different character, yet from its more general distribution, it may be regarded as offering the most distinctive type of the formation. The more remarkable associated varieties of rock will be noticed in the more detailed accounts which follow.

The most striking features, in this formation, are presented by its subordinate ranges of Limestone. These very generally occupy valleys, of greater or less extent, which, by their direction, offer perhaps the best key to the arrangement of the whole formation. I have already referred to a remarkable Limestone valley (†,) or rather series of valleys, extending along the Eastern border of the formation, throughout nearly its entire extent. The first, in this series, commences, on the S. W., at the point on Byram river, in North Greenwich, already noticed, and extends N. N. E. along that stream, to Byram Pond. Crossing a ridge N. E., in which are contained subordinate beds of Limestone, we meet another valley, with Limestone, on Miannus river, extending N. E. to Bedford, and then bearing E. N. E., in which direction it soon terminates. Crossing another ridge, we find another Limestone valley, that of Cross river, bearing first E. N. E., and then turning N. N. E. to South Salem. Parallel to the latter part of this valley, another extends in the same direction N. N. E. along the valley of Mill river, commencing in Poundridge (N. Y.,) near the N. line of Stamford, and extending to the source of

that stream, N. W. of Ridgefield village. This valley, towards the N., is divided, by an interposed ridge of Micaceous Gneiss, into two branches; one, on the East, following the course of Mill river, as above described; the other, on the West, proceeding more Northerly, by Cross Pond, into South Salem. These two valleys, however, apparently unite again, N. of Ridgefield village. The united valley then extends E. N. E., conformably to the course of the Eastern border of the formation, into the N. W. corner of Reading, where it unites, on the N. W., with the Eastern termination of a Limestone valley extending W., along the course of Titicus river, through North Salem; thus forming a wider valley, traversed by several ranges of Limestone, alternating with ridges of Micaceous Gneiss, along the immediate Eastern border of the formation. It is here bounded on the North, by a high, abrupt and narrow ridge (†,) extending East from Ridgebury to the narrow valley opening S. from Danbury to the Saugatuck. The Limestone extends N. through this latter valley, bounded W. by the East point of the ridge last mentioned, and E. by the S. point of a high ridge of Red Porphyritic rock, extending N. by Bethel village, into a remarkable isolated ridge E. of Danbury, called Shelt Rock. At Danbury, the Limestone valley from the S. unites with a valley from the West (*,) extending along the course of Still river, by Mill Plain (Ridgebury,) to the Croton in Southeast (N. Y.) This valley also contains traces of limestone; but slight, however, till towards its Western extremity, in New York. Crossing the porphyritic range of Shelt Rock, the Limestone range extends again N. N. E. in an uninterrupted valley, in which the Limestone is apparently nearly as uninterrupted, along the course of Still river, through Brookfield, and then through New Milford and New Preston, till it terminates in the manner already described. This last Limestone valley also extends along the immediate Eastern border of the formation. In tracing this range of Limestone valleys, we observe a series of flexures, namely, first N. E., then E. N. E., again N. E., then E. N. E., and at

last N. N. E., with a short flexure to the N. E. at its termination, corresponding to the direction of the preceding formations, as marked by the Eastern border of the present formation.

The valley (*,) extending W. from Danbury, may be regarded as dividing the present formation into two sections, Northern and Southern, differing in direction, and in some respects, in the character of their rocks. Of these, the Southern (1) will be first considered. Only a small part of this section lies within the limits of this State; but having traversed, in connexion with my survey, that part of it lying within the angle, included by a line drawn from the N. W. corner of Greenwich, to the point where the Mill Plain valley crosses the line of the State, I am enabled to describe it with more certainty than if I had confined myself within the limits of Connecticut.

The peculiar Micaceous rock of the present formation is, on the whole, more distinctly marked and predominant in this than in the Northern section. It is generally marked by stripes of darker and lighter shades; the lighter, in some instances, having a peculiar reddish tint. This is particularly striking, in the ridge West of the Limestone valley of North Greenwich. Garnets occasionally occur in this rock, but less frequently when more remote from the limestone. Generally the Micaceous rock, accompanying the limestone, is garnetiferous and also ferruginous, from the presence of pyrites. Beds of a more pyritiferous variety occasionally occur in the Micaceous rock remote from the limestone, sometimes with traces of plumbago. Alternate beds also occur, of a coarser grained micaceous rock, somewhat resembling the sub-porphyritic veined rock (β E,) in structure. The mica of this formation is generally very dark, but occasionally of a deep blue, approaching that of (2 F.) Subordinate beds and ranges of porphyritic and sub-porphyritic rock occur, which will be noticed in connexion with their local relations. Beds of Hornblende are not unfrequent, both uniform and thinly schistose, and

thicker bedded and slightly sub-porphyritic. Generally the Hornblende of this section is very dark, often deep black, corresponding with the mica, in this respect. Beds and veins of coarse and fine red and white felspathic Granite are more or less frequent; the red more generally occurring in the dark Micaceous rock; the white, in connexion with the limestone. These beds or veins, particularly the larger, are usually distinctly parallel, both in position and structure. Even the coarser varieties present a distinctly parallel arrangement, with a structure often strikingly porphyritic. The red granite of this section often presents traces of copper, indicated by the green carbonate on the weathered surface. Subordinate beds or ranges of Granitic Gneiss also occur in this section; generally white, but occasionally reddish felspathic. This rock, particularly when connected with the limestone, is often distinctly veined sub-porphyritic in its structure, and this peculiarity may be traced to some distance in the Granitic Gneiss of (F 3,) immediately adjoining the Limestone valleys on the Eastern border of the present formation, particularly in that of Ridgefield. Along the Eastern border of the North Greenwich Limestone valley, extends a ridge, chiefly composed of a light grey granitic gneiss (with alternate beds of white limestone, and bordered on the East by a band of light green Pyroxenic limestone,) in which this peculiar sub-porphyritic structure is very obvious. One of the most remarkable rocks in this section is the light green Pyroxenic limestone, just alluded to. This generally occurs in small beds, in the Micaceous ridges interposed between the Limestone valleys, where it is sometimes accompanied with small beds of white limestone, and also associated with black Hornblende, and small veins of Granite. It is usually very decomposible and ferruginous, but its fine grain and brilliant colour would render it, if not too hard to be wrought, valuable as a material for ornament.

Besides the series of Limestone valleys extending along the border of this formation, already noticed, a few others may be

alluded to, within the limits above indicated. A valley extends West from South Salem, towards Cross river village, in which are found traces of limestone. This is separated from the limestone valley of Cross river, above noticed, by a high abrupt ridge (the Raven Rocks,) chiefly composed of the dark Micaceous rock of the present formation, around the Eastern point of which, however, the two valleys communicate. Another limestone valley, farther N. W. (at Todd's Quarry,) extends nearly East and West, and in nearly the same line, farther East, is another valley (that of Long Pond,) separated by intervening ridges, in which is also found a small range of limestone. These two last are nearly in the line of the S. part of the Eastern limestone valley, already noticed, N. E. of Ridgefield. The valley at Todd's Quarry apparently communicates with that of North Salem by a narrow valley, bearing N. E., also containing beds of limestone. These statements would seem to indicate that the same undulating course, in the direction of the different ranges, observed on its Eastern border, pervades the whole formation. The arrangement is, however, too complex to be presented, at present, in its details.

The Limestone of this section is generally a very pure white Dolomite, more rarely bluish. It is usually finer grained and decomposible, frequently decomposing to a considerable depth, into a loose sand or gravel. Occasionally it occurs of a very coarse grain, and highly crystalline. This variety is considered as furnishing the strongest lime, and is found especially at Hill's Quarry (Reading,) Todd's (South Salem,) and Slosson's (North Salem.) Beds occasionally occur, highly ferruginous from pyrites, and the micaceous gneiss adjoining, is generally quite ferruginous, as already noticed. The limestone of this section is usually accompanied with beds or veins of a coarse white felspathic Granite, both traversing the limestone, and the micaceous rocks adjoining; those in the former, generally smaller and more felspathic. Beds of Hornblende, and of a peculiar light grey porphyritic rock, also occur very frequently

in connexion with the limestone, either in lateral or interposed ranges. The latter rock is peculiarly abundant in the Limestone valley of Byram river, in North Greenwich. The limestone of this section also frequently includes small veins and nodules of a bluish white pyroxene, which indeed is a very general accompaniment of the limestones in the Western part of the State. Beds of light green pyroxene are also found in the vicinity of the limestone of the present section. A range of such beds occurs at the Southern termination of the North Greenwich Limestone valley, W. of Byram river, associated with dark Hornblende, coarse white Granite, and the peculiar porphyritic rock, just referred to.

Two local ranges, within the limits of the present section, claim a more particular notice. A remarkable range (a) of a dark porphyritic and sub-porphyritic rock, similar, in its general character, to the Western porphyritic ranges of (F,) namely, (1—4—7,) and still more resembling the porphyritic formation, West of Litchfield, (G S. 3ζ,) extends, in a narrow ridge, along the Eastern side of the Miannus Limestone valley, from Northcastle to Bedford village, whence it may be traced, in a narrow range, first adjoining the Eastern termination of that valley, on the North, and then S. and S. E. of the Limestone valley of Cross river, following the course of the latter to the North, to a point, East of the Raven Rocks, between the latter valley and the Limestone valley of Cross Pond. The basis of the peculiar rock of this range is generally very dark micaceous, more or less sub-hornblendic, fine-grained, like the predominant micaceous rock of the present formation, and more or less thick-bedded and prismatic. Like the rock of (G S. 3ζ,) it is generally porphyritic with purple felspar. This variety alternates with other dark micaceous, more thinly schistose rocks, either coarser grained, and more veined sub-porphyritic, or finer grained, and more uniform in structure. Beds, generally small, of a fine-grained dark Hornblende are not unfrequent. The high narrow ridge (t,) already referred to, between the Eastern Limestone valley (t,) in Ridgefield and

Reading, on the South, and the Mill Plain valley (*,) on the North, may be regarded as a distinct range (β,) from the peculiar character of its rocks. This range is characterized by a predominance of Granitic rocks, generally with white, but occasionally with reddish felspar. These rocks are distinctly parallel or gneissoid in their structure, of a lighter or darker grey, often with garnets disseminated, and are accompanied with subordinate alternations of Micaceous rocks, also with garnets, and with frequent beds of dark fine-grained Hornblende. The generic character of these rocks, resembles that of the formation generally. This ridge, by its isolated and abrupt outline, presents a striking feature in the topography of the country. The present section is throughout characterized by its peculiar broken surface, from the frequent alternation of high narrow ridges and deep valleys, presenting a strong contrast to the more uniform surface of the formation (F) adjoining.

2. The Northern section of the present formation (H) includes all that portion of it, North of the Mill Plain valley (*,) extending West from Danbury to the Croton river. I shall confine my remarks on this section to that part of the formation lying East of the Croton river, although the country West of that river, and S. of the Dover Limestone valley, is included within the limits of the present formation. Throughout this section, some general traits of resemblance may be observed in the character of the rocks, which identify them as members of the same general formation as the preceding section, but at the same time local peculiarities occur, which permit of a subdivision into several subordinate ranges.

(α.) The most remarkable of these is the Red Porphyritic range of Shelt Rock, already noticed. This, although of considerable extent, in the direction of its length, is generally quite narrow, but subject to successive enlargements and contractions. Its general direction is N. N. W.; not, however, in one uniform line, but by successive shifts or recessions. This range commences distinctly, in a high abrupt point, East of the Eastern Limestone valley (†,) about a mile N. of Hill's

Quarry (Reading,) and opposite the Eastern termination of the ridge (1β.) A porphyritic rock, of a similar character, accompanies, however, the limestone at Hill's Quarry, forming a narrow band along the E. side of the Limestone valley (†,) adjoining the Micaceous range (F 5 s.) From the point, above mentioned, this range extends North, in a high ridge, along the East side of the Limestone valley (†,) and adjoining (F 5 s) on the West, to Bethel village, where its elevation is interrupted; then N. Westerly, in the ridge of Shelt Rock, E. of Danbury, crossing the Limestone valley (†) obliquely, by a series of recessions to the West; then after another depression, where it forms only a very narrow subordinate band, it again rises in a high ridge (Bear Mountain,) West of Neversink Swamp, and spreading to a greater width, than farther South, extends N. N. W. by the E. side of New Fairfield village, still skirting the Neversink Swamp on the West, and further North along the West side of Osborn's Hollow, a valley opening into the basin of the latter from the N. W., till it terminates in a point, not far N. of the S. line of Sherman. The predominant rock, in this range, is a thick bedded sub-granitic, large red porphyritic rock, more or less seamed with a dark greenish (sub-chloritic) mica, and occasionally sub-hornblendic. The darker, more micaceous variety is most common, generally with purplish porphyritic felspar; but not unfrequently large beds occur, with a distinct porphyritic structure, yet hardly less felspathic than Granite. These have generally a lighter red porphyritic felspar. The thick bedded porphyritic rock is accompanied more or less by more thinly schistose dark micaceous, or sub-hornblendic, sub-porphyritic alternations. Veins of coarse Granite are not unfrequent, and in these the parallel veined porphyritic structure is often quite obvious.

A narrow valley opens N. from the Limestone valley (†,) in Danbury, along the E. side of the depression in the Porphyritic range (a,) above noticed, to the S. end of the basin of Neversink Swamp, and from the latter, a continuous valley extends by Osborn's Hollow, around the N. point of the Porphyritic

range ($\alpha_,$) to Haviland's Hollow, which opens S. Westerly into the valley of Croton river, where it issues from the Dover limestone valley. That part of the present section (2,) West of the Northern half of the Porphyritic formation ($\alpha_,$) is thus insulated by deep valleys, and may be considered as forming an extensive plateau ($\beta_,$) in which, however, considerable variety in the character of the rocks may be observed. In the Southern and Western part of it, two or three valleys may be traced nearly from West to East, in lines parallel to the Mill Plain valley ($^*_,$) separated by intervening ridges, in the same general direction, while in the more Northern and Eastern part, the direction conforms to that of the adjoining Porphyritic formation. In the latter part of this division ($\beta_,$) the strata are generally very irregular and contorted. The central part of this division forms a more elevated and uniform plateau, W. S. W. of New Fairfield, nearly covered with Diluvium. In that part of this division, S. of the high central plateau, the predominant rock is the peculiar dark or light grey fine-grained Micaceous rock of the present formation. The lighter grey frequently has a delicate purple tint, in its mica, resembling that of a similar Micaceous rock in a remarkable formation (D,) in the Eastern Primary. The Micaceous rocks of that part of the present division frequently contain garnets, and are generally more or less ferruginous. Subordinate beds of a very ferruginous variety occur, filled with disseminated scales of Plumbago, and occasionally larger points of Plumbago are observed, particularly in connexion with small quartz or granite veins. Subordinate beds of Hornblende are not unfrequent, generally dark and fine-grained, occasionally coarser and sub-porphyritic. These are peculiarly abundant along the E. side of the valley of Croton river, near Milltown (N. Y.,) forming there even extensive subordinate ranges. Beds or subordinate ranges of a light grey Granitic Gneiss are not unfrequent also. In a high ridge, commencing near the line of the State, and extending in an undulating course Easterly between the two most Southern valleys, in this di-

vision, such a Granitic Gneiss forms the predominant rock, as in the ridge (1 β,) S. of Mill Plain valley. Like the Granitic Gneiss of that range, it also contains garnets, and is associated with large beds of dark Hornblende. The high central plateau is so completely covered with diluvium, that, in crossing it, I observed the rock exposed only in three points, namely, along its Eastern and Western borders, and in a valley, near its middle, opening South. The predominant rock, in those points, was a very coarse-grained, light grey, porphyritic veined contorted rock, generally with white, but occasionally with reddish felspathic veins, with frequent larger veins or beds of a coarse white, or reddish white, distinctly veined porphyritic Granite. The N. W. part of the present division, adjoining Haviland's Hollow, consists chiefly of the dark and light grey fine-grained Micaceous Gneiss of the formation generally, here usually abounding in small tortuous veins of red and white Granite, with frequent beds of dark Hornblendic and sub-hornblendic rock, and occasional large beds of a veined porphyritic red felspathic Granite, with parallel seams and patches of dark mica and Hornblende. This range characterized by its red veined, dark micaceous rocks may be traced S. W. through the country West of the Croton, between Carmel and Somers (N. Y.) The only trace of Limestone, I have observed, within the limits of the present division (β,) is on the E. side of the Croton, N. E. of Milltown (N. Y.) and on the N. side of the Granitic range, in that vicinity, already described. There is here a bed, of no great extent, of an impure ferruginous limestone, accompanied with green pyroxene and plumbago.

(γ.) Under this head, is included all that part of the Northern section (2,) lying East of the Red Porphyritic range (α,) and of the S. part of the Kent Limestone valley (ε.) From the Southern extremity of the latter, a valley (Leach's Hollow) opens S. into Neversink Swamp, nearly at the same point with Osborn's Hollow, already referred to, thus completing the Western boundary of the present division (γ.) This

division includes, on its Eastern border, the great Limestone valley (t,) already described, extending from the N. of Bethel, along the course of Still river, through Brookfield, to the Housatonic at New Milford, whence it is continued through New Preston, to its N. E. termination, near the Shepaug. The rock, in this valley, consists chiefly of white Limestone, particularly towards its Northern extremity, alternating with a light grey, generally even, striped Micaceous Gneiss, with large beds, in some parts, of a very coarse white Granite, and with occasional beds of a light grey porphyritic rock, quite similar to that accompanying the limestone in the Southern section (1.) The limestone of this valley is generally Dolomitic, but beds occasionally occur in it of a purer carbonate of lime, one of which, in the N. E. part of Danbury, has been lately wrought by Mr. L. S. Platt, for purposes of agriculture. Usually the limestone is fine-grained, partly very decomposible, and in part harder and of a pure white, forming an elegant marble. The marble quarries of New Preston, near the N. termination of the valley, have long been noted. A vein of Galena has been worked, to a small extent, in the limestone, West of Still river, in Brookfield.

That part of the present division, West of this Limestone valley, consists apparently of a series of alternate ranges of a more felspathic sub-granitic gneiss (t,) and of a darker more micaceous gneiss (t;) the different ranges of each, possessing, in the whole, a common character, identifying them as parts of a common formation. The predominant rock, in the sub-granitic ranges (t,) is a very fine-grained, light grey, darker and lighter striped Gneiss, with thin seams of very dark mica, with the grain and lustre, peculiar to the Micaceous rocks of the present formation (H.) Not unfrequently the lighter stripes have a reddish tint, as has been already noticed in the micaceous striped rocks of the Southern section (1.) More generally the rocks of this class are even, but occasionally they are found highly contorted. Very frequently the stripes are not of uniform width, but successively enlarge and con-

tract, giving to the rock a porphyritic veined aspect. Small parallel veins of white or reddish veined porphyritic felspathic Granite are not uncommon, occasionally accompanied with thin bands of dark Hornblende. Larger interposed beds of white and reddish veined porphyritic Granite also occur, particularly in the Southern part of the present division, W. of the Limestone valley in Brookfield. Subordinate beds of a light grey Granitic Gneiss, more or less similar in structure to the predominant rock of the class, are not unfrequent. A remarkable range of a very light grey or white albitic Granitic rock (††,) extends throughout this division, obliquely N. N. W., in a direction nearly parallel to the Red Porphyritic range (α,) as will be afterwards specified. The sub-granitic and granitic rocks of this class are generally albitic in their composition, often readily decomposing into a porcelain or infusible clay. The Micaceous rocks (‡) of the present division will be more particularly described as they occur.

The most extensive and important range ([1],) in this division, consists of rocks of the first class (†,) accompanied with the granitic range (††,) just referred to. This commences on the West side of the Limestone valley of Still river, in the N. part of Danbury, and extends North, immediately adjoining the rocks of the valley, till West of Brookfield; occupying the greater part of the country between that valley on the East, and the Neversink Swamp, on the West. West of Brookfield, a narrow Micaceous range ([3]) begins to be interposed between it and the Limestone valley East. It, however, continues North, occupying the greater part of the ridge between the Limestone valley, East, and Rocky river, the outlet of Neversink Swamp, West. Crossing this stream, it also occupies the ridge between it and Leach's Hollow (farther N. between the Housatonic and the S. part of the Kent Limestone valley, in Sherman.) Crossing the Housatonic, it extends N. along the W. border of the present division, by the Kent ore bed, terminating in a point, a short distance farther N. It immediately adjoins the W. border of the present division, from

the central wider part of Neversink Swamp, Northward. The subordinate range of Granitic Gneiss (††,) above alluded to, generally traverses the more central part of this range; through the greater part of its extent, with little interruption. It may be observed, in its Southern part, in Danbury, adjoining the Limestone valley (†;) but it is there apparently more interrupted. From a point West of Brookfield, Northward, it is apparently more continuous; first traversing the summit of the ridge, W. of the Limestone valley (†;) then crossing Rocky river, and continuing along the ridge W. of the Housatonic, by Hine's clay bed, to a point N. of the New Milford and Sherman road, when, after crossing the latter river, it bears more N. E., by Peet's clay bed, to its N. termination in the ridge East of the Kent ore bed. The Granitic rock of this subordinate range abounds in a pure white albite, often giving to its weathered surface a brilliant white aspect. From this circumstance also, it is at times very decomposible, forming beds of infusible clay, (as at Hine's, W. of New Milford,) in which the structure of the rock is distinctly preserved. The beds and veins of coarse white Granite, traversing this Granitic rock (††,) and also the more micaceous rocks of the present range (1,) are occasionally very decomposible, forming a more perfect porcelain clay, from the more complete segregation of the felspar (albite.) Instances of this occur at Peet's clay bed, already alluded to, in connexion with the subordinate Granitic range (††,) and in the ridge E. of the Sherman valley (s,) in connexion with the more micaceous (sub-granitic) rocks of the present range (1.) The clay, thus formed, is, in the latter instance, though very purely felspathic, frequently liable to ferruginous stains, rendering it less fitted for porcelain. The Granitic rock of the present range (1) is often apparently well suited for quarrying. In the ridge, W. of the Housatonic, N. of the Sherman road, I have observed small beds of limestone, accompanying both the Granitic and more micaceous rocks of the range; in one instance, accompanied with large beds of coarse white Granite and grey Quartz; in another, with seams and patches of green Pyroxene.

Adjoining the range (1,) on the West, S. of the central part of Neversink Swamp, along the E. side of which it extends S. into Danbury, is a narrow range (2) of a thin dark Micaceous ferruginous Gneiss, with more or less frequent beds or veins of coarse and fine-grained white or reddish Granite and Granitic Gneiss. These beds are all very similar in their structure and arrangement, but their parallelism is more obvious in the finer grained varieties. Generally, in the coarser varieties, the ground is finer grained white felspathic, with veined porphyritic reddish felspar disseminated; the weathered surface, at the same time, nearly uniformly white. A similar veined porphyritic Granite, with brighter red felspar, occurs frequently in the adjoining part of the preceding range (1.) This Micaceous range (2) is, however, most strongly marked by its ferruginous character. Near its N. termination, in a ridge E. of the Neversink Swamp, in a very ferruginous Micaceous Gneiss, is an important vein of magnetic pyrites, formerly used in the manufacture of copperas.

Along the Eastern border of the preceding range (1,) another very narrow Micaceous range (3) extends N. at least from Brookfield to the Housatonic, immediately adjoining the Limestone valley (†) on the West. It also occupies the ridge, on the N. bank of the Housatonic, West of the entrance of the Aspetuck, now intersected by the Housatonic Rail Road. The characteristic rock of this range is a coarse, thick bedded, dark grey Micaceous rock, with veined porphyritic points, chiefly composed of a coarse flaky white Mica, blended with more or less of felspar and quartz, giving to the surface of the rock a peculiar knotted appearance. Alternate beds occur of a finer grained, more schistose Micaceous Gneiss, partly uniform, and partly with a lighter ground, marked by parallel flakes of shining black mica, and other beds of a dark fine-grained Hornblende; also veins of a coarse white Granite, with subordinate veins or patches of quartz, sometimes accompanied with black tourmaline. The beds of Hornblende are most extensive along the W. border, towards the sub-granitic range (1.) Sometimes

beds of the coarse knotted Micaceous rock alternate with beds of limestone and granite, on the W. border of the Limestone valley (†.) The Micaceous rocks of this range are generally decomposible and ferruginous. This Micaceous range ($^{3}_{,}$) in a part of its course, is interrupted, appearing in singular short isolated ridges, rising along the West side of the Limestone valley (†.)

In that part of the present division ($\gamma_{,}$) E. of the Housatonic, the number of alternate ranges of the two classes (sub-granitic and micaceous) is greater than in that, already described, on the West. Proceeding West from the Limestone valley (†,) in New Preston, we cross a ridge (*) to the valley of the West Aspetuck, in which a light grey, often reddish, Granitic Gneiss predominates. This range apparently commences in the angle of the East and West Aspetuck, N. of New Milford. A bed of pyritiferous magnetic iron occurs in this range, in New Preston. In the valley of the West Aspetuck, is a narrow range of the coarse knotted Micaceous rock of ($^{3}_{,}$) very decomposible and ferruginous; apparently in the same line as the range ($^{3}_{,}$) continued N. from the ridge, above noticed, in the West angle of the Housatonic and the Aspetuck. The ridge W. of the valley of the West Aspetuck, is occupied by a narrow range of the light grey striped sub-granitic Gneiss of ($^{1}_{,}$) apparently in the same line as that of the ridge W. of the Limestone valley (†,) S. of the Housatonic. On the Eastern declivity of this ridge, a bed of Hematite has recently been opened, included in a variety of Micaceous rock, somewhat resembling the characteristic rock of the range ($^{3}_{,}$) but apparently subordinate to the sub-granitic rock of the ridge in which it is situated. This rock has a fine-grained, dark grey ground, with large porphyritic points of a coarse white mica, including a few grains of quartz and felspar. It is generally decomposed in the bed to a soft clay, but still perfectly retaining its original structure. The hematite occurs in parallel veins or patches, in the decomposed rock, and like all the hematite ores in the State, is apparently a secondary for-

mation, derived from the decomposition of the pyrites disseminated through the rock. In the valley of a small stream, farther West, is another narrow range of coarse Micaceous ferruginous rock, similar to that of (3.) In a valley farther N. N. E., not far S. of the New Preston and Kent Turnpike, is a small subordinate range of White Limestone (‖1) (Bostwick's,) and another (‖2,) of rather greater extent, apparently in the same line, occurs on the N. bank of the Housatonic, near the bridge on the road from New Milford to Sherman. These Limestone ranges are evidently isolated. The Micaceous range, last noticed, forms, however, apparently a connecting link between the two Limestone ranges. In a low ridge, separating the valley of that range from that of the Northern Limestone range (‖1,) beds of white Limestone are observed, interposed in a similar Micaceous Gneiss, with beds of Hornblende. The valley of the Northern Limestone range opens into that of the West Aspetuck, not far North of the ore bed just noticed. Farther West, near the Housatonic, is another ridge, occupied by the sub-granitic rock of (1,) terminating in a point S. of the New Preston Turnpike. This is apparently connected with a range of similar rock, extending along the N. bank of the Housatonic, at the bridge on the road to Sherman. The rock at the latter point is highly contorted.

West of the valley occupied by the Northern Limestone range, just referred to, at the New Preston Turnpike, we cross the S. point of a ridge of a dark Micaceous ferruginous Gneiss (‡,) alternately coarser and finer grained, which may be traced in a higher ridge, farther South, West of that last noticed; this Micaceous range thus advancing N. Easterly, conformably to the direction of the range (1,) towards its N. termination. A peculiar coarse-grained lighter grey variety (ŧ) occurs in the Southern part of this range, generally very decomposible in shelly fragments, characterized by veined porphyritic quartz and felspar (the former generally most abundant,) imbedded in a dark silvery micaceous ground, occasionally with porphyritic points of coarse flaky white mica, much resembling

the knotted rock of the preceding Micaceous ranges, and yet quite distinct. This usually occurs in large beds, accompanied with alternate bands of a coarse more or less tortuous veined sub-micaceous variety, and a thinner more uniform darker micaceous variety. The finer grained micaceous rocks of this range, generally present more or less distinctly the knotted structure, already noticed. This range adjoins the N. termination of the range (^{1},) on the East, and apparently terminates towards the S., in a point E. of the Housatonic, above the road from New Milford to Sherman. The most extensive formation of limestone, connected with this part of the present division (γ,) occupies the remarkable circular valley or basin, known as Kent Hollow (¶,) at the head of the valley of the West Aspetuck. This is situated on the immediate Northern frontier, assigned to the present formation (H,) and is bordered on the W. by a range of sub-granitic rocks, in the line of the range West of the West Aspetuck, and on the N. and E. by ridges, belonging to the next succeeding formation (I.) The limestone in the centre of the valley alternates with white Granitic and light grey sub-granitic rocks, slightly sub-porphyritic in structure. The limestone, so far as I observed it, generally abounds in veins or patches of quartz, tremolite and white pyroxene. This range of limestone may be considered as a continuation of the series formed by the two smaller Limestone ranges (‖1—‖2,) in a N. E. direction, conformably to the general N. E. direction of the present formation (H,) at its Northern extremity.

(δ.) Under this head, is included all that part of the Northern section (2,) North of (α) and (β,) and West of the Southern termination of the Kent Limestone valley (ϵ,) in Sherman. It includes two distinctly marked ranges, apparently very irregular in their outline. The first (^{1}) surrounds the N. point of the Red Porphyritic range (α,) from which it is separated by Osborn's and Haviland's Hollows, communicating with each other, as already observed, at the N. point of (α.) This range is apparently a continuation of the dark micaceous veined range,

adjoining Haviland's Hollow on the S., already noticed in connexion with (β_1) which bending round the N. point of (α_1) sends down a narrow ridge, between Osborn's and Leach's Hollows, to their point of junction in Neversink Swamp, while at the same time it is continued N. in a high ridge, near the W. line of the State, between Sherman village and Quaker Hill (N. Y.) The predominant rock of this range is the fine-grained, dark micaceous, striped and veined Gneiss, common to the more Southern parts of the present formation (H_1) with occasional alternations of a coarser grained, more veined sub-porphyritic variety, and with more or less frequent subordinate beds of Granitic and Hornblendic Gneiss. Hornblendic beds or subordinate ranges are peculiarly abundant in that part of the range more immediately adjoining the Porphyritic range (α_1) more especially in the ridge E. of Osborn's Hollow, in which Hornblendic rocks quite predominate. The Hornblende of this range is generally fine-grained, dark and uniform, and frequently abounding in small tortuous Granitic veins. The Micaceous Gneiss, accompanying it, is also similarly veined, and often traversed with irregular seams and patches of Hornblende. The red felspathic veins of the range S. of Haviland's Hollow, are less obvious in the present range.

West of this, a wider range (^{2}) extends N. from Haviland's Hollow, along the E. side of the Dover Limestone valley, to the valley by which Dover river passes E. to the Housatonic, where it apparently bends East, extending in a high narrow ridge, along the S. side of the latter valley, and then sends down a process along the E. side of the Kent valley, in Sherman, thus surrounding the preceding range (^{1}) on the North, in the same manner that the latter surrounds the Porphyritic range (α_1) as already noticed. The predominant rock of this range is a coarse-grained, darker or lighter silvery Micaceous rock, generally thick-bedded and contorted, often knotted with porphyritic points of quartz and white mica, and accompanied with garnets. It alternates with a finer grained, darker micaceous, more even and fissile variety, generally very ferruginous. Oc-

casionally large beds occur of the quartzose veined porphyritic variety, already noticed (ϛ) in describing the N. E. part of the preceding division (γ,) and as in that instance, very decomposible. This occurs particularly on the E. side of the ridge, S. of Dover river, as the present range bends S. along the West side of the Kent Limestone valley (ε.) The Micaceous rocks in this range, from the predominance of quartz in their composition, might often be called a Mica Slate, if such a distinction were of any importance. Large and small veins of coarse and fine White Granite are frequent, particularly in the Eastern part of the range. The smaller veins are generally very much contorted. In the N. W. part of this range is an isolated formation of white Limestone, of no great extent, occupying a valley or basin, S. of the high ridge, adjoining Dover river, already noticed. In tracing this valley S. W., the Limestone is interrupted, but the Micaceous rocks, throughout its course, are generally very ferruginous. Beds of Hematite of small extent have been opened in different points in this valley; the most important near its Southern termination, adjoining a small range of ferruginous decomposible Limestone, with green pyroxene disseminated. The Hematite is there found in a decomposed coarse silvery Micaceous Gneiss, with garnets, less distinctly marked by porphyritic points of white mica, than the rock accompanying the Hematite, East of the Kent Limestone valley (ε.) The ore of this locality is apparently of a superior quality, but was found in too small quantity to warrant its exploration.

(ε.) The Kent Limestone valley may be here connected with the present formation (H,) although it is in part more immediately connected with the next succeeding formation (I.) The Limestone of this valley may be traced distinctly from a point S. of Sherman village, to a point, on the E. side of the Housatonic, near Lewis' Bridge, in the S. W. part of Cornwall. The valley is continued farther S. through Leach's Hollow, already noticed, to the centre of the Neversink basin. In this latter part of its course, I have observed two distinctly marked lo-

calities of limestone, on the opposite sides of the valley, near its junction with that basin. The beds, however, are there very small. From Sherman, Northward, large beds occur frequently, forming an almost continuous range through the valley, as far N. at least as the line of Cornwall, N. of which the valley becomes very narrow, and the limestone is only occasionally apparent. Cornwall Hollow, extending in a winding course, N. Easterly, through that town, may be regarded as a continuation of the Kent valley, connecting it with the S. Canaan Limestone valley. Limestone occurs in it, at least in that part of it N. of the Sharon and Goshen Turnpike, as will be afterwards noticed. The Kent valley is widest, opposite the entrance of Dover river, by the valley of which it communicates with the Dover Limestone valley, on the West. In its Southern part, it is bounded East by the range (γ^1,) and West by the range (δ,) of the present section of (H.) Farther N., the next succeeding formation (I 1) borders it on the East, and the Granitic formation (K 1,) on the West. From the latter, it is generally separated by the Housatonic. N. of the Housatonic, near Gaylord's Bridge, a cove of this valley extends N. E. along the West side of the range (γ^1,) to a point not far N. of the Kent ore bed. Along the E. side of this cove, S. of the ore bed, extends a low ridge of light grey Quartz rock, and at the ore bed, situated on the W. side of (γ^1,) a bed of very ferruginous (pyritiferous) Quartz rock occurs in connexion with the Gneiss of that range. The Hematite of the ore bed is situated chiefly in a larger bed, closely adjoining the bed of Quartz on the W., but partly more remote, in a wide band of decomposed Micaceous rock, with porphyritic patches of coarse white mica, very similar to the varieties already noticed both in (γ) and (δ.) This rock is, however, coarser grained than that at the ore bed, adjoining the valley of the West Aspetuck, noticed under (γ,) and more resembling the rock of ($\frac{1}{2}\gamma$,) and that on the Eastern border of (δ) S. of Dover river. This rock is reduced, to the depth of many feet, at the ore bed, almost entirely to the state of a soft clay, yet retaining its original structure distinct-

ly. The Hematite is included in it, as at the ore bed on the West Aspetuck, in parallel veins or isolated patches, and like that of the latter locality, is obviously derived from the decomposition of the pyrites in the decomposed rock. In the larger body of ore, adjoining the Quartz rock, on the East, masses occur of a brecciated Quartz, cemented by the Hematite, and associated with a yellow brown jasper. The ore of this bed, particularly adjoining the Quartz rock, is often filled more or less with seams of minute crystalline Quartz, and is then said to be *frosted*, by the miners. This ore is generally rejected, as unfit for the furnace. The cove, last mentioned, is bounded on the N. by the S. point of the high abrupt escarpment of the formation (I 1,) bounding the Kent valley on the East, farther N.

The Limestone of this valley is generally a fine-grained white Dolomite, similar to that in the more Southern and Eastern parts of the present formation, and is often very decomposible and ferruginous. A fine-grained bluish variety occurs more frequently than in the preceding ranges. The beds of Limestone alternate with a dark grey Micaceous rock, generally coarse-grained, and more or less allied to the Micaceous rock of (δ,) and of the succeeding formation (I.) Among its varieties may be enumerated a coarse knotted, thick-bedded variety, with garnets, and another coarse-grained, dark micaceous, porphyritic veined variety, generally much contorted. Beds of a finer grained, more even and thinly schistose Micaceous Gneiss also occur. Veins of coarse Granite and beds of Hornblende are less frequent, particularly in the more Northern part of the valley, than in connexion with the Limestone farther South and East.

A few general remarks may here be offered on the Hematite ores, connected with different ranges in the Northern part of the present section (2.) The three deposits, that have been most extensively worked, namely, that at the Kent ore bed, that on the West Aspetuck, and that near the Western border of (δ,) are all situated in the vicinity of ranges of Limestone, and are connected with a decomposed rock, more or less char-

acterized by porphyritic points of coarse white mica. In other localities, where this rock is found, particularly on the N. E. border of (δ,) adjoining the Kent Limestone valley (ε,) traces of Hematite are also observed, and in the latter range, the rock occasionally appears as a soft ferruginous red or yellow clay, having the appearance of an ochre. These associations of the Hematite may be of great economical importance, as furnishing a guide for the discovery of new deposits of that ore.

The present formation (H) will be best considered, in its general relations, in connexion with the next succeeding formation (I,) which lies in the same line of direction towards the N. E. It may here be remarked, however, that the general direction of the present formation is N. Easterly, in a very undulating course; in its Northern section, directed more to the N., corresponding to the direction of the adjoining portion of (G,) but at its N. termination, again bearing toward the N. East.

I. *A Micaceous Ferruginous Formation* (Gneiss.)

Under this head, is included an extensive range, in the same general line of direction as the preceding formation, of which it may be regarded as a continuation; characterized throughout by a dark micaceous Gneiss, more or less ferruginous. Its Eastern border commences at the East Aspetuck, in New Preston, near its issue from Romaug Pond, and at first extends N. E., in the high rocky ridge of Pinnacle Mt., along the W. side of the New Preston Limestone valley, to the Northern termination of the latter. It then bears East, across the Shepaug, adjoining the Mica Slate range (G S. 3 ε,) to the S. W. corner of the Porphyritic formation (G S. 3 ζ,) around the Western and Northern border of which last it extends (at first in a narrow ridge between it and the Shepaug,) till it meets the Western border of the Mica Slate formation (G,) W. N. W. of Litchfield. From that point, it adjoins the formation (G,) on the East, to the most Northern point of my exploration. Its boundary on the South, towards the preceding formation (H,) has already been indicated. Its Western border is very

irregular in its outline, much more so even than the Western border of the adjoining range on the East, namely, that of (G.) It at first proceeds nearly N. along the East side of the Kent Limestone valley (H 2 s,) as already noticed, and then in a very undulating course N. Easterly, by the East side of Cornwall Hollow, to the head of the South Canaan Limestone valley. The long narrow winding valley, known as Cornwall Hollow, may be considered as forming a connexion between the Kent and South Canaan Limestone valleys, and in its North part, at least, beds occur of a very decomposible and ferruginous white limestone, accompanied with veins and nodules of white pyroxene. From the head of South Canaan Hollow, the present formation extends N. W. in the high tabular ridge of Canaan Mountain, which forms a promontory between the two Limestone valleys of South and North Canaan. These latter are properly coves of the great Western Limestone valley (L,) (that of Berkshire and Dover,) penetrating into the formations adjoining it on the East. From the head of the North Canaan valley, the Western border of the present formation extends S. Easterly, along the Western border of a Granitic formation (K 2,) to the South point of the latter, at Wolcottville. At this point, the present formation forms only a narrow band, intervening between (K 2) and the formation (G,) on the South. The Western border of the present formation is again directed to the N. E. along the East side of (K 2,) from which it is at first separated by the valley of Still river, and after crossing Farmington river, bears more Northerly into Massachusetts. From the above statement, it will be perceived, that the present formation is nearly intersected by the opposing points of (K 2,) on the N. E., and (G S. 3 $\frac{1}{2}$—4,) on the S. W. It may thus be considered as divided into two sections, namely, a S. Western and a N. Eastern, which are, however, apparently connected by a narrow band, curving round the S. point of (K 2,) at Wolcottville.

The Micaceous rocks of the present formation are throughout characterized by the dark shade of their mica, and are

generally strikingly ferruginous; the ledges being often distinguishable at a distance by their rusted surface. Subordinate beds and ranges of micaceous rock occur, however, of a different character. Still the ferruginous character of the formation is very obvious, even in its soils and waters. This formation is also characterized by large beds and subordinate ranges of a white or light grey felspathic (albitic) Granitic rock, both coarse and fine-grained, generally distinctly parallel, and often strikingly porphyritic in its structure. Rocks of such a character may be traced throughout a great part of the formation, as will be afterwards more particularly specified. Hornblende is not unfrequent in some parts of the formation, particularly in the vicinity of granitic ranges, and on its borders. It is generally dark, fine-grained and uniform; more rarely sub-porphyritic (sienitic.) Athough this formation is in the line of the Calciferous formation (H,) yet I have in no instance observed any distinct traces of limestone, in its interior, unless in one slight instance, in its Northern section, hereafter specified.

1. The Southern section includes all that part of this formation, West of the narrow band interposed between the North point of (G S. 3 η—θ) and the South point of (K 2,) already indicated. Although it adjoins the preceding formation (H,) on the South, by a line transverse to the general direction of both, yet it presents, in the whole, quite a distinct, though allied character. In both, a dark micaceous gneiss predominates, but that variety, so characteristic of the preceding formation, is apparently not continued in the present. The Micaceous rocks of this formation rather resemble those of the range (H 2 δ 2,) and of the more micaceous ranges in that part of (H 2 γ,) East of the Housatonic. The S. W. point of the present section lies opposite the high ridge of the former range, South of the valley of Dover river, in an E. N. E. direction, and resembles it not a little in the peculiar character of its micaceous rocks. From this point, the rocks of the present formation apparently curve Easterly around the N. point

of the subordinate Granitic range (H 2 γ 1,) and are thence continued along the N. side of Kent Hollow and Romaug Pond. In this line, the more micaceous ranges of (H 2 γ E.) apparently coalesce with them, while the Granitic range (H 2 γ 1,) and the sub-granitic ranges, farther East, either terminate abruptly, or soon run out. The Granitic range, just noticed, may perhaps be continued in a more interrupted range of granitic beds (†) in the same direction, N. E., near the Spectacle Ponds, West of Warren, and the most Eastern sub-granitic range (that West of the New Preston Limestone valley,) is apparently connected with a narrow band of similar sub-granitic rocks, at the N. E. angle of Romaug Pond. The Limestone of the preceding formation obviously terminates at the transverse line above specified. Along this line, from the cove of the Kent valley (H 2 ε,) at the ore bed, a range of depressions extends across to the outlet of Romaug Pond, North of which the present formation exhibits, as it were, the high escarpment of a plateau.

The predominant rock of the present section resembles rather the finer grained, more thinly schistose varieties of the Micaceous ranges of (H,) with which it apparently corresponds; but the coarser grained, both the knotted and veined porphyritic varieties of those ranges, also occur, particularly along the Western border, adjoining the Kent valley, and along the Southern frontier, above indicated. Subordinate beds of a similar kind occasionally occur throughout the section. The knotted variety is generally garnetiferous, and sometimes contains large nodules of iron pyrites. The porphyritic points, which give its peculiar character to this variety, like those in the similar varieties in the Northern part of (H,) consist chiefly of a flaky white mica, with more or less of felspar and quartz, and often with minute included garnets. The predominant rock of this section, as already observed, is generally thinly schistose and rather even, dark micaceous, more rarely silvery shaded, generally lighter striped or veined, and occasionally, though less frequently than the coarser varie-

ties, accompanied with garnets. It is usually very ferruginous, though not often, in such instances, very decomposible. Its surface, and the beds of the streams, adjoining, are often highly rusted. Subordinate beds sometimes occur, less ferruginous, and then generally more granitic veined, or traversed more with small beds of granitic gneiss, and with a more silvery shaded mica. Subordinate beds of granitic gneiss, generally white (albitic,) but occasionally reddish, are not unfrequent. This section is also traversed by several very remarkable subordinate ranges of a white (albitic) Granitic rock, already referred to, in the more general account of the formation. One (†,) less continuous, on the S. W., in the vicinity of the Spectacle Ponds, has been already noticed. This is accompanied with numerous beds of dark green Hornblende, and also with a coarse, very contorted veined Micaceous rock. A more extensive range (‡) may apparently be traced through the greater part of a circuit concentric to the exterior outline of the section, and inclosing a large tract of the Micaceous rock of the formation, in its centre. The course of this range is laid down on the map, marked by dotted lines, where it has been distinctly ascertained. In some of my routes, the surface was too much covered with Diluvium, to enable me to decide with certainty. It apparently, from the direction of its strata, and of those of the adjoining Micaceous rock, forms a curve, between Warren and Milton, conformable to the S. W. outline of the present section. From this point, where it is of greater width than in other parts of its course, it appears to send out two branches, one of which may be traced N. E. through the Western part of the section, across the S. E. corner of Cornwall, by the West of Goshen village, and along the N. W. side of Ivy Mountain (North Goshen,) while the other passes East, between Milton village and the Porphyritic formation (GS. 3ζ,) at Prospect Mountain, whence it bears N. Easterly through the S. E. part of Goshen, and bending N. extends along the ridge W. of the valley of the Naugatuck, on the Eastern border of the present section. In the more Northern part of this section, only smaller beds of

Granitic rock have been observed. A range (*,) however, of considerable extent, apparently in a line farther West than the West branch of the preceding range, crosses the Albany Turnpike at the top of the ascent from Canaan Hollow, at Roberts' (North Goshen.) Much of this consists of a coarse-grained Granite, but conformable, in its structure and arrangement, with the finer grained, more gneissoid part of the range. The Granitic rock of this and the preceding range is often well adapted for architectural purposes. Small beds occasionally occur in the Micaceous rocks of this section, particularly in the vicinity of the Granitic ranges, of a rather coarse Granitic rock, composed almost entirely of Quartz and white Mica, with only a few grains of Felspar disseminated.

The greater part of the present section may be considered as forming an extensive plateau, extending through Warren, Goshen, and parts of the adjoining towns. A large portion of its surface, particularly in Goshen, is covered with Diluvium. In this Diluvium, blocks of white limestone are not unfrequently found, similar to that of Canaan. These were so frequent, at the first settlement of the country, that several lime-kilns were erected for burning them; but no trace of limestone has yet been found, to my knowledge, in the rocks of the present section. Along the whole of its Western border, towards the Limestone valleys, adjoining it, this section presents a high steep escarpment, and in that part adjoining Cornwall Hollow, an elevated ridge, the highest summit of which is called Mohawk Mountain (W. of Goshen.) Ivy Mountain is a conspicuous summit, rising nearly in the centre of the N. part of this section, and although not more than 300—400 feet above the general level of the plateau, commands a view extending from the mountains in Haddam and Chatham, on the S. E., to the Catskill Mountains on the N. W.; thus indicating the comparatively great elevation of the general surface of the country around it. This section, on the N., runs out in a narrow point (Canaan Mountain,) bearing N. W. between the valleys of North and South Canaan. A narrow range of a coarse veined and

knotted Micaceous rock, similar to the corresponding variety in the present section, runs N. along the W. side of the Granitic formation (K2,) at least till within the limits of Massachusetts.

2. The Northern section includes all that part of the present formation N. E. of the narrow interval between (GS.3η—δ) and (K2,) or of the Naugatuck at Wolcottville. From the resemblance of the rocks, occupying the interval, just noticed, to those of the present formation, I have considered the two sections of the latter as connected in the manner specified. The rocks in this interval are a dark micaceous veined Gneiss, with frequent interposed beds of white Granitic rock, similar to that of the formation generally. Very large beds of this latter rock occur at Wolcottville, well adapted for quarrying. The Northern section forms generally a band of moderate, but rather variable width, between the formations (G) and (K2,) extending first N. Easterly, in an undulating course, to Farmington river, and then bearing more Northerly, along the West side of the East branch of the latter, into Massachusetts. It occupies, on the S. border of that State, the country from Tolland village, West, to West Granville village, East, and farther N. may be traced, in a band of no great width, near the West border of Blandford. The ferruginous character of its rocks is there very obvious.

The predominant rock of this section is a dark micaceous, thinly schistose, more or less ferruginous Gneiss; generally accompanied more or less frequently with small white Granitic beds or veins, and also with subordinate Granitic ranges, very similar to those of the preceding section. These Granitic rocks might be considered, indeed, from their peculiar composition and structure, as the most characteristic rocks of the formation, and as those which serve best to trace it throughout its long and devious course. Along the Western border of this section, extends a subordinate range, characterized by a coarser grained, more silvery shaded, granitic veined or striped Micaceous Gneiss, accompanied with frequent beds of white and more rarely reddish Felspathic Gneiss. This is most ob-

vious in that part of the section along the E. side of Still river valley, and thence N. to the line of the State. The rocks of this latter range are less ferruginous than those of the section in general. In both the micaceous and felspathic varieties, a porphyritic veined structure, similar to that of the Granitic rock of (K,) is more or less distinctly observable. The greater portion of the present section, from Farmington river Northward, is occupied by a darker, less veined, very ferruginous Micaceous Gneiss, not unfrequently accompanied with beds of dark Hornblende, usually fine-grained, uniform, and more or less thinly schistose. These beds are most frequent on the borders of this section, both its Eastern and Western, forming there subordinate ranges of considerable extent, as in West Hartland, adjoining the valley of the E. branch of Farmington river. A large bed or subordinate range of a rather coarse subporphyritic (sienitic) Hornblendic rock, with large porphyritic points of Hornblende, and occasionally with garnets, occurs in this section, about half way between Tolland and West Granville (Mass.) Garnets are not unfrequent in the Micaceous rocks of this section. The most extensive beds or ranges of Granitic rock, in this section, are in the high ridge of Torringford, E. of the village, and in that part of the section, between Farmington river and the East branch of the same, (where it also forms a high tabular ridge,) both in Barkhamsted and Hartland. This rock is quarried to some extent, in the latter range, E. of Hitchcocksville. The only trace of limestone, I have observed in this section, is a very small bed of an impure ferruginous variety, S. of West Hartland, in the vicinity of extensive beds of Hornblende. A range of limestone may, however, be traced, near its Western border, within the limits of (K2,) as will be afterwards explained. The surface of this section is generally characterized by long even ridges, in the line of its direction, which form a striking contrast with the broken surface of the formation (K2,) adjoining it on the West.

The two formations (H) and (I,) taken together, form a con-

nected range, coextensive with that of (F—E—G,) on the East, crossing the State obliquely N. E. from New York into Massachusetts, and then bearing more directly North. This range presents a series of flexures or undulations, in its course, corresponding to those of the ranges farther East, but more strongly marked than the latter. The two formations have a general resemblance to each other, in the character of their rocks, nearer than that of either to the formations adjoining them, on the East or West, and yet with certain differences, as has been already specified, somewhat corresponding to the differences between (F) and (G,) also in the same line of direction. This division of the different ranges by a transverse line will be more fully explained, when I come to treat of the general relations of the whole Western Primary. The most remarkable difference between the two formations (H) and (I,) is the comparative abundance of limestone in the former, and the almost total absence of it in the latter. The highly ferruginous character of (I) is perhaps worthy of remark, in connexion with this circumstance.

K.

Under this head, is included a series of isolated formations, which, from the prevailing character of their rocks, might be termed

Granitic Formations (Gneiss.)

These extend in a range, parallel to that of the two preceding formations, first N. Easterly, and then more directly North, but are separated by the interposition of formations of a different character. The first of these, towards the S. W., is the Granitic range of the Highlands (K 3.) This I have examined particularly, in connexion with this survey, only at three points, near its N. E. termination, but having traversed it farther S. W., I have no hesitation in connecting it with the present series. The second, in order, towards the N. E., is a Granitic formation (K 1,) commencing in Schaghticoke Mt., N. of the cross valley of Dover river, and extend-

ing N. through the West part of Kent, and through Sharon and Cornwall, into S. Canaan. This is separated from the preceding by the Dover Limestone valley (L,) and a narrow range of Mica Slate (M,) adjoining the latter on the West. The S. point of (K 1) is in a direction N. of E. from the extreme N. point of the Granitic Gneiss of the Highlands, corresponding to the latter, in position, in a manner similar to the relation of the S. W. point of the formation (I) to the N. E. point of (H $2\delta^2$,) already noticed. The third, in the present series of formations, is a Granitic formation (K 2,) commencing in a point, just North of Wolcottville, and extending, in a direction nearly North, into Massachusetts. This is separated from (K 1,) by the interposition of the preceding formation (I.) Its S. point is situated about S. E. from the N. E. point of (K 1;) thus giving to the entire range an outline very similar to that of the range formed by (H) and (I.)

The predominant rock in these formations is Granitic; more generally a white felspathic striped or veined, dark mica seamed Gneiss; the felspathic stripes or layers usually much wider than the micaceous, sometimes quite even, but more frequently enlarging and contracting, and more or less contorted. The rocks of the latter variety assume more or less a porphyritic veined structure, analogous to that of (E β.) Porphyritic rocks, of different varieties, also occur in all these formations, particularly in the two S. Western. The more granitic rocks are accompanied in all, by peculiar varieties of Micaceous and Hornblendic rock. Pyroxenic rocks also occur in all of them, associated both with limestone and plumbago. Limestone, in small subordinate beds or ranges, and Magnetic Iron are also common to them all, and ranges of Quartz rock, of considerable extent, are found in each of them, particularly near their junction with the adjoining Calcareous formations. These formations are all characterized, more or less strikingly, by the peculiar broken form of their surface, varied by detached rounded elevations, particularly remarkable in the N. E. formation (K 2.) In what I have farther to state, I shall

confine myself chiefly to the two formations (K 1) and (K 2,) situated partly within the limits of this State, reserving a few remarks respecting the Granitic range of the Highlands, to the conclusion.

1. This forms an elevated range, or rather plateau, generally with steep escarpments, completely isolated by valleys. It is bounded on the East by the Kent Limestone valley, and its continuation in Cornwall Hollow; on the N. E. by the Limestone valley of South Canaan; on the West and N. W. by the Dover Limestone valley, and its continuation through Sharon, Salisbury and Canaan; and on the South by the cross valley of Dover river. The valleys on the East and N. E. separate it from the Southern section of the preceding formation (I 1,) and the valley on the South from the Micaceous range (H 2 δ^2.) In other directions, it adjoins the Calcareous formation (L.) It rises, on the North of the valley last mentioned, in a bold point, called Schaghticoke Mt., whence it spreads out, particularly on the West, to an average width of four or five miles, and extends N. N. Easterly, between Kent and Dover, into the Eastern part of Sharon, and then, crossing the Housatonic, more N. Easterly, through the N. W. part of Cornwall, into S. Canaan. It there terminates in a low ridge, called the Cobble, ranging nearly W. N. W., between the North and South branches of the South Canaan valley, above referred to. The surface of this range is characterized, particularly in its N. Eastern part, East of the Housatonic, by the detached rounded elevations, common to the whole series.

The predominant rock of this formation, is the white felspathic, dark mica seamed Granitic Gneiss, characteristic of the whole series; generally in this formation, more even, than in the succeeding formation (K 2,) and varying, by the different proportions of its felspar and mica, from a nearly white, thicker, more granitic variety, to a lighter or darker grey, thinner and more schistose sub-granitic variety. These varieties occur in alternate beds, the one or the other predominating in different sections of the formation. Along the

Eastern border of the formation, in Cornwall, extends a range, in which a thick white Granitic Gneiss predominates; very liable to disintegration in large blocks. The more granitic rocks of this formation are readily distinguished from those of the preceding, by their peculiar veined and seamed structure, as compared with the sub-porphyritic structure of the latter. The darker seamed Granitic rocks of this formation often have a strikingly porphyritic veined structure, from the enlargement and contraction of their felspathic layers, and in the Southern part of the formation, especially, subordinate ranges of Porphyritic rock occur, some of them quite extensive. The most remarkable of these (α) extends along the East side of the formation, adjoining the Housatonic, from the point of Schaghticoke Mt., for some distance Northward. This is characterized by a very thick bedded, large red porphyritic rock, generally little seamed with mica, alternating with darker more micaceous sub-porphyritic, and dark grey striped sub-micaceous varieties, with occasional beds of dark Hornblende. The rocks of this range present striking analogies to those of the Red Porphyritic range (H 2 α,) and are indeed situated in the line of direction of the latter, Northward, being separated from it by the interposition of (H 2 δ) and the cross valley of Dover river. This would seem to indicate that the range (H 2 α) is continued thus far North, forming a band, parallel to the Western outline of the formation (G,) of a common character throughout, although connected, in its course, with two distinct formations (H) and (K.) This subject will be farther considered in connexion with the general relations of the Western Primary. Farther W., in the Southern part of the formation, is another range (β,) characterized by beds of a darker smaller porphyritic rock, with white or purple porphyritic felspar, accompanied with similar alternations. In this range, not far West of the line of the State, is a bed of serpentine, and near the line of the State, on the East, a large bed of green pyroxene, accompanied with limestone and dark hornblende. The latter crosses the valley of the W.

branch of the stream in the West of Kent, near its junction with the Eastern branch from the Macedonia Furnace.

Alternate beds and subordinate ranges of dark Micaceous Gneiss occur in various parts of the present formation, especially along its Western border, where they apparently form a continuous range of considerable extent, particularly in Sharon. This rock is usually fine-grained, darker and lighter striped, and not unlike the peculiar dark Micaceous rock of the Calciferous formation (H.) It occasionally alternates with lighter sub-granitic beds, similar to the peculiar rock of (H 2 γ^1.) Beds of dark fine-grained Hornblendic and sub-hornblendic rocks are not unfrequent, particularly in the range E. of Sharon. The rocks of this latter range are especially characterized by alternate harder and softer layers, which, from the greater decomposability of the latter, give to the weathered surface of the rock a grooved or fluted aspect. Beds of black or dark green, usually fine-grained Hornblende also occur in connexion with the more granitic rocks of the formation; occasionally very ferruginous, from the presence of pyrites. A large bed of such a ferruginous variety, near the line of Kent and Sharon, was formerly worked, as a plaster for manure (called the Black or Whitten's Plaster—the latter name from its discoverer.) The fertilizing property of this substance, if it possesses any, may be owing to the same cause as that of the bluish mica slate, employed for a similar purpose in Washington; namely, to the combined action of the sulphate of iron, derived from the decomposition of the pyrites, with the lime of the Hornblende (generally in the proportion of 12 to 13 per cent.) Beds of a bright green pyroxene occur in different localities in this formation, particularly in the Eastern part of it. One has been already noticed, in connexion with limestone. Another may be traced, farther N. E., on the Eastern declivity of the formation, West of the Housatonic, and still farther N. E., on the East side of the Housatonic, in Cornwall, is a locality of similar pyroxene, forming small beds in a thin grey ferruginous gneiss, and accompanied with

seams and patches of plumbago. Magnetic iron is another mineral, which may be considered characteristic of the present formation. A vein of some extent occurs on its Eastern border, West of the Housatonic, in the S. E. part of Sharon, and grains of the same are disseminated in the more granitic rocks generally.

Although this formation is nearly surrounded by a series of limestone valleys, yet I have observed only two distinct localities of limestone within its limits, one of which has been already indicated. The other is situated at the head of a remarkable valley, extending South into the present formation, from the Limestone valley (L,) at Lime Rock village, in Salisbury, nearly to the Sharon and Goshen Turnpike. The limestone there forms a bed of no great width, which may be traced from the head of the valley, where it is quarried for lime (Weed's Quarry,) about half a mile S. to the Turnpike. It is accompanied with alternate beds of a light grey granitic and a darker more micaceous gneiss, both marked by the peculiar characteristics of the present formation. This valley is separated, on the West, from the Limestone valley (L,) in Sharon, by a high narrow rocky ridge, occupied, in its Southern part, by the peculiar rocks along the Western border of the present formation, including, on its W. declivity, large beds of Hornblende, and of a very coarse, parallel, dark mica flaked, white felspathic Granite (granitic gneiss,) and in its Northern part, by a coarse, dark silvery Mica Slate, analogous to that in the adjoining part of the Limestone valley (L,) in Salisbury. This Mica Slate is apparently continued farther South on the East side of the ridge, adjoining the valley; the Granitic rocks of the present formation being extended, as a process, into the Calcareous formation (L,) on the N. W.

Several subordinate ranges of Quartz rock are included in the present formation, generally on its immediate borders, where it meets the adjacent Calcareous formations. Such a range apparently extends along its Western border, from the S. W. point of Schaghticoke Mt., at least into the S. W. part

of Sharon. Another, farther in the interior of the formation, extends, at least from the Sharon and Goshen Turnpike, along the high ridge E. of the valley, North of Weed's Quarry, above mentioned, and then, after crossing the Housatonic, in a direction nearly East, parallel to the North border of the formation, adjoining the South Canaan valley. A similar range of Quartz rock, of small extent, occurs on the East border of the formation, West of St. Andrew's Church (Kent.) These ranges are accompanied with a peculiar very fine-grained, light grey quartzy felspathic Gneiss, also found in other localities on the immediate frontier of this formation, as at the N. W. point of the Cobble, at South Canaan meeting-house. This rock, as well as the Quartz rock with which it is associated, is often brightly coloured with red, yellow and purple ferruginous stains, from minute disseminated pyrites. In the N. E. part of the formation, in Cornwall, subordinate ranges occur of a coarse, lighter grey, veined Micaceous Gneiss, somewhat resembling the coarser Micaceous varieties of the preceding formation, but still with a distinctive character, peculiar to the present formation. Beds of coarse white Granite are more frequent in that, than in other parts of the formation.

2. This formation is considerably more extensive than the preceding, occupying, on the N. line of the State, a width from the Western border of Norfolk to the Eastern border of Colebrook, and apparently of greater extent in Massachusetts, than within the limits of this State. It commences, on the South, in a point near Wolcottville, and thence extends North, spreading out in a fan-like form, through the centre of Torrington, and through Winchester, Colebrook and Norfolk, into New Marlborough, Sandisfield, and the West part of Tolland (Mass.) This formation forms, in the whole, an extensive plateau, running down to a bold point, N. of Wolcottville, between the valley of Still river, East, and that of the W. branch of the Naugatuck, West. The waters of the greater portion of this plateau flow S. and E. to the Nauga-

tuck and Farmington river; the line, marking the turning point of the waters, being comparatively near the Western border of the formation. The surface of this formation resembles that of the preceding, being marked, in a still more striking manner, by detached rounded or conical summits, with intervening circular hollows or basins, in several instances, occupied by ponds. These summits are more particularly remarkable on the E. and W. borders of the formation. A singular group of them occurs on the W. border, N. W. of Norfolk, the highest summit of which is called the Haycock, from its peculiar form. The Micaceous formations (I 1) and (I 2,) contiguous on the West and East, generally present long, smooth, even ridges, contrasting strongly with the broken surface of the present formation. This is particularly striking on its E. border, in Tolland (Mass.) This formation is bounded East by the N. E. section of the preceding Micaceous formation (I 2,) being separated from it, on the S., by a long straight valley, that of Still river, extending N. Easterly from Wolcottville to Hitchcocksville, and thus connecting the valleys of Farmington river and the Naugatuck. Farther N. the E. boundary is less distinctly marked. On the West, it is bounded by the S. West section of the preceding Micaceous formation (I 1,) from its South point to the head of North Canaan Hollow, and farther North, by the great Limestone valley of Berkshire.

The predominant rock of this formation is a light grey, generally white, more rarely reddish felspathic Granitic Gneiss, with parallel seams of black mica; generally more or less contorted, and with a more or less distinctly porphyritic veined structure. This rock is very similar to the Granitic Gneiss of the preceding formation, but is usually more irregular and tortuous. It presents alternations of coarser, more granitic, and finer grained, more micaceous varieties, and is accompanied with beds or subordinate ranges of dark or light grey Micaceous Gneiss, very similar to that of the preceding formation, and not unfrequently with subordinate beds or veins of Horn-

blende, generally dark and fine-grained, as in the same formation. Porphyritic varieties are less frequent among the Granitic rocks of this formation, than in the preceding. Subordinate beds of a dark mica seamed, veined porphyritic rock occur, however, along its Western border, as in the vicinity of Norfolk village. Beds or subordinate ranges of a more uniform, white felspathic Granite, or Granitic Gneiss, generally fine-grained, occur in some parts of the formation, as at the Upper village (Winsted,) where it is accompanied with epidotic seams, and is well adapted for quarrying. Granitic rocks of a similar kind also occur along the W. border of the formation, E. of North Goshen. Along its Eastern border, adjoining the valley of Still river, from its S. point Northward, is a range characterized by interposed beds, often large, of a coarse and fine-grained red felspathic Granitic rock (Granite,) often breaking in small prismatic fragments. These beds alternate with a lighter grey, more silvery shaded Micaceous rock, usually ferruginous (pyritiferous,) resembling, by its rusted surface, the rocks of the Micaceous formations (I1—2,) but obviously distinct in structure, conformably to the general character of the present formation, and more analogous to the coarser micaceous rocks, in the N. E. part of the preceding formation (K1.) Subordinate Micaceous ranges, of a similar character, but rarely accompanied with red granite, as above, occur farther West in the formation, sometimes of considerable extent; as, for instance, in a ridge N. of Winsted (Upper village,) and again between West and East Otis (Mass.)

Along the Eastern border of the formation, near its line of junction with the Micaceous formation (I2,) occurs a range of white Limestone, usually of small extent, and apparently interrupted. This Limestone is generally impure, with crystalline quartz and green pyroxene more or less abundantly disseminated, and is sometimes very decomposable and ferruginous. It is found, in greatest quantity, in the vicinity of Hitchcocksville, extending from the Falls of Still river, near its junction with Sandy river, to the E. side of Farmington river,

N. of that village. It is also traceable on the Eastern border of the formation, W. of Tolland (Mass.) In the same range, W. of Hitchcocksville, occurs a bed of Serpentine, accompanied with traces of white quartzy limestone, and also with pyroxene and hornblende. On the summit of the declivity, W. of Still river, N. E. of Winsted, is a locality of magnetic iron, in small veins and seams, traversing a light grey, white felspathic Gneiss. Grains of magnetic iron are not unfrequently disseminated through the Granitic rocks of this formation, as has already been noticed in the preceding formation (K1.)

Along the W. border of this formation, the rocks, both Granitic and Micaceous, are generally more evenly striped, and finer grained, resembling those on the Western border of the preceding formation, and like those, accompanied with more frequent beds of dark Hornblende. Occasionally, on the immediate Western border, as at Norfolk village, beds occur of a coarse veined and knotted Micaceous Gneiss, resembling not a little the knotted Micaceous rock of the formation (I1,) and still more nearly connected with the narrow range of coarse Micaceous rock, extending along the W. border of the present formation, N. of the head of North Canaan Hollow, as already noticed under the same formation (I1.) The peculiar knotted appearance of the rock is owing to disseminated porphyritic points or nodules, chiefly composed of white flaky mica and quartz. Along the W. border, at least N. of Norfolk, beds occur of a dark green pyroxene, similar to that accompanying the preceding formation (K1.) with garnets and pyrites disseminated. Along the immediate W. border, near the N. line of the State, where the present formation adjoins the Limestone of (L_1) on the W., extends a range of a fine-grained white or light grey Quartz rock, often filled with minute pyrites and very decomposable, and partly breaking in small prismatic fragments. Among these, fragments of a ferruginous seamed quartz breccia occur; the seams perhaps derived from the decomposition of the pyrites of the quartz, and its recomposition as a hematite. Farther N., on the W. side of the formation, in New Marlbo-

rough and Tyringham (Mass.,) is an extensive Calciferous range, included within its limits, as will be more particularly explained, in connexion with the succeeding Calciferous formation (L.) The limestone generally occupies subordinate ranges, in valleys or lower ridges, between which are interposed higher ridges of a Granitic or sub-granitic Gneiss, generally finer grained and more even, and apparently more quartzose, than the Granitic rock of the central part of the formation, on the East. The limestone is also generally accompanied with beds of Quartz rock, and on the immediate Western border, adjoining the Limestone valley of the Housatonic, is another extensive range of Quartz rock, resembling that, in a similar position, farther South. Farther East, nearly in the centre of that part of the formation, a small bed of Limestone, in a light grey Granitic Gneiss, accompanied with a light greenish pyroxenic rock, is found in the ridge W. of Farmington river, in Otis (Mass.) The greater part of the surface of the present formation is covered with diluvium; partly, perhaps, from the circumstance, that the micaceous rocks are very generally, and the dark mica seamed granitic rocks not unfrequently, decomposable and ferruginous.

The Granitic range of the Highlands (K3) may here be slightly noticed, in connexion with the two preceding formations, to which, as already observed, it is apparently analogous. It gradually runs out in a point, W. S. W. from the S. point of the formation (K1,) and but little N. of the road from Dover to Beekman (N. Y.) by Johnson's meeting-house. On the E., it apparently adjoins the Calciferous formation (H,) near Carmel; and farther N., (from the S. W. corner of the Dover Limestone valley (L) Northward,) it is contiguous, in the same direction, to a narrow range of Mica Slate (M,) bordering that valley on the West. At the line of junction with the latter range, the Granitic rocks of the present range (K3) dip to the East, underlying the Mica Slate. On the West, this range adjoins the extensive range of blue limestone, with argillite, of Dutchess Co. (P.). At its N. E. termination, it presents, near the Mica

Slate, a band chiefly composed of a thin even dark mica seamed Granitic or sub-granitic Gneiss, and farther W. beds of a veined porphyritic rock, similar to that on the Western border of the two preceding formations (K 1—2,) and others of a whiter more granitic Gneiss (Granite.) A range of Quartz rock apparently extends along its W. border, adjoining the Limestone (P,) from near its N. termination to the S. road from Carmel to Fishkill. Subordinate beds of Limestone occur within its limits, as within those of the two preceding formations, and like those, it is characterized by its pyroxene and magnetic iron.

The three formations (K 3—1—2,) taken together, form a series, of a common character, ranging N. E. in (K 3—1,) and then bearing N. in (K 2;) thus presenting a curve, conformable to that of the great ranges farther East. They are, at the same time, separated from each other by the interposition of Micaceous formations, in a manner similar to the arrangement of the series of Granitic basins (those of Bristol, Canton and Granby,) in the Micaceous formation (G.)

L. *A Calciferous Formation* (that of the Limestone valley of Dover and Berkshire.)

This very extensive valley, which forms the most remarkable feature in that part of the country, through which it extends, lies chiefly beyond the limits of this State, only crossing it obliquely through Sharon, Salisbury and Canaan. It terminates, on the South, in Patterson (N. Y.,) in a basin, occupied by an extensive swamp, from the S. E. point of which the Croton issues. The Calciferous (Gneiss) formation (H) surrounds it, on the South, into which it sends two or three narrow branches, also with limestone. On the East, it is bordered by the same formation (H,) towards the South, and farther North, by the Granitic formation (K 1,) between which it communicates with the Kent Limestone valley, by the cross valley of Dover river. North of (K 1,) it adjoins the Micaceous formation (I 1,) on the East, at Canaan Mt., and farther

North, it is bordered on the East by the Granitic formation (K 2.) On the West, it is bordered, throughout its whole extent, at least as far North as Egremont (Mass.,) by a narrow range of Mica Slate (M;) in its Southern part, of moderate elevation, and continued in nearly an uniform direction, N. N. E., but in the N. W. part of Salisbury, rising into the high ridge of Taconic Mt., extending North between New York and Massachusetts. This latter range might be considered an appendage of the Limestone valley, as its rocks are not unlike the Mica Slate, alternating with the limestone of the valley; but as it forms a distinct feature in the topography of the country, it may be treated separately.

The present formation is characterized by a great predominance of limestone, forming not merely subordinate beds, but extensive ranges. This limestone is generally white, but sometimes blue; the latter variety occurring more frequently than in the limestone accompanying the formations already noticed, farther East. In North Canaan, a variety occurs, striped blue and red, but the latter colour is derived from a ferruginous stain. The limestone of this formation is generally a Dolomite, but beds of a purer carbonate of lime occasionally are met with. It occurs both coarse and fine-grained, and hard and decomposable, in alternate beds or strata. The coarser and less decomposable varieties are considered preferable for lime and as a flux for iron ores. In Dover, Canaan and Berkshire, both the white and blue varieties, more particularly the former, are worked as marble. The limestone of this valley has a structure corresponding to that of the micaceous rock accompanying it, more particularly the blue variety. The latter, especially in that part of the valley adjoining the Granitic formation (K 1,) in Salisbury and Sharon, has often a porphyritic veined structure, strikingly analogous to that of the Granitic Gneiss of that formation; thus evincing that the limestone, in its original formation, was subject to the same influences, as even the more granitic rocks of parallel structure. White pyroxene is frequent in the lime-

stone of this valley, particularly in Canaan and the Eastern part of Salisbury. It occurs distinctly crystallized, foliated, and in small irregular veins and nodules, and in South Canaan, in extensive beds and subordinate ranges, forming a distinct and peculiar rock. This rock forms a range, several rods in width, extending N. Westerly one to two miles, parallel to the West front of Canaan Mt., in the Western part of the South Canaan valley, and also occurs in large interposed beds, in a low spur of limestone, projecting from the N. W. point of the same mountain. This rock is particularly characterized by breaking in very regular square blocks, with a surface often somewhat eroded. The greater part of the range, above noticed, consists of very evenly parallel beds of this rock, with thin interposed beds or layers of limestone. From the greater decomposability of the latter, the pyroxenic rocks generally are considerably elevated above the surface, in the manner of a dike. Fetid quartz and tremolite frequently occur in the limestone of this formation, particularly in that of South Canaan, adjoining Canaan Mt. The limestone in that vicinity is often in a great measure composed of irregular veins and nodules of these minerals, accompanied with the white pyroxene. Blocks of this variety are frequently found in the diluvium of Goshen.

The limestone of this formation generally appears in low ridges or swells in the bottom of the valley, but occasionally in ridges or plateaus of considerable elevation, particularly in the country between Salisbury and Sharon. It sometimes rises high on the sides of the valley, particularly on the East, where it occasionally underlies distinctly the adjacent formations, as at Canaan Mt. (I 1) and East of Dover (K 1.) It is accompanied throughout with Mica Slate, sometimes forming thin interposed beds, and at other times extensive ranges. The Mica Slate, in the vicinity of the limestone, particularly when interposed in thin layers in the beds of the latter, is very generally dark and plumbaginous, but occasionally light grey, as in the more extended ranges. These latter usually

occupy high narrow abrupt ridges, sometimes quite isolated, and at other times in longer ranges, generally with an irregular outline. The Mica Slate, in its more extended ranges, is generally thin and light grey, sometimes more plated and silvery, sometimes with a finer grain and a duller more talcose aspect. This latter variety is more remarkable in that part of the valley, North of the parallel of Canaan Mt., and has often a striking resemblance, in structure, to the thinner sub-granitic and micaceous rocks of the preceding formations (K 1—2,) but differing in the greater predominance of mica and quartz in its composition. Subordinate beds occur, in these ranges, of a thicker, dark bluish, or nearly black, plumbaginous variety, similar to that more immediately connected with the limestone, and sometimes accompanied with a dark, bluish Hornblende. This latter variety, and occasionally the lighter grey, are very ferruginous (pyritiferous;) the lighter grey usually furnishing by its decomposition a yellow oxide, and the darker variety a dark red brown oxide, somewhat resembling the Hematite. No important beds of the latter ore have been found in the Eastern or central parts of the valley, but I have occasionally observed thin seams of it, well characterized, in the dark plumbaginous Mica Slate, particularly towards the Western part of the valley. The Hematitic range will be pointed out in connexion with the succeeding formation (M.) A coarse dark silvery Mica Slate, veined or knotted with quartz, and often abounding in staurotides and garnets, occurs especially in the North part of the ridge bounding, on the West, the valley South of Lime Rock village, already noticed in connexion with (K 1,) and in the continuation of that ridge Northward, along the West side of the Housatonic. In that part of the formation, North of Canaan Mt., large beds or subordinate ranges of white or light grey Quartz rock traverse the limestone; generally breaking in large blocks or small prismatic fragments, and often very pyritiferous, like the range adjoining the formation (K 2,) in the same part of the valley, already noticed. In the vicinity

of one of these Quartz ranges, not far West of North Canaan meeting-house, seams of a red Hematite are found in a very decomposable and ferruginous limestone. The connexion of Quartz rock with the limestone of Tyringham, included within the Granitic formation (K 2,) has been already referred to.

From its Southern termination to Sharon, the present formation occupies a deep and straight valley, of nearly uniform width, and comparatively level, with only a few low limestone swells, and detached and steeper Mica Slate ridges.* Viewed from the adjoining heights, this valley appears like a vast trench, between the abrupt declivities that border it. This part of the formation lies entirely within the limits of New York State, and has been already referred to as the Dover Limestone valley. The Mica Slate range (M) extends, in nearly a straight line, along its Western border. Along its Eastern border, adjoining (H) and (K 1,) its outline is generally very regular; but a large cove, occupied partly by limestone, projects from it into the range ($2\delta^2$) in the formation (H,) between Patterson and Pawling (N. Y.,) and in the interval between (H) and (K 1,) it communiates with the Kent Limestone valley, by a transverse valley, at Dover river, in part, at least, occupied by limestone. On the N. side of this latter valley, a cove extends E. from the main valley, W. of Schaghticoke Mountain, in the S. W. part of which are situated the Dover Marble Quarries, chiefly composed of a very pure white limestone. The direction of the main valley is here about N. by E. From Sharon to Salisbury, the valley extends more N. N. Easterly, generally with a more elevated surface; the limestone occupying high and broad plateaus, particularly along its Eastern border. A line of depressions follows, however, the chain of ponds between Sharon and Salisbury, and opens a communication between the lower levels of the main valley, in Dover and Sheffield. In the S. part of Salisbury, the valley

* In this valley, a level of nearly thirty miles in extent, was surveyed by the Sharon Canal Company, from Patterson (N. Y.) to the Western border of this State, in Sharon.

expands to a greater width, from the recession of the Granitic formation (K1) Eastward, and crossing the Housatonic into Canaan, sends out branches into the formations on the East, namely, the South Canaan valley, extending E. S. E. between (K1) on the S., and (I1) (Canaan Mountain) on the N., and divided into two smaller valleys, by a low ridge (the Cobble,) connected with the Granitic formation (K1,) and the North Canaan valley, extending E. along the N. border of Canaan Mountain (I1.) The latter is properly a cove of the Berkshire valley. North of Canaan Mountain, the main valley becomes still wider, extending, near the line of the State, from the Taconic Mountain, on the West, to near the West line of New Marlborough (Mass.,) on the East. It here bears more directly N., forming the great valley of the Housatonic, in Berkshire. The general surface of the valley, in the N. part of Salisbury, in Canaan, and in the adjoining part of Massachusetts, is low and level, but traversed by ridges of Mica Slate, often high and abrupt, either isolated, or in long continuous ranges, the latter generally presenting a distinctly curved outline. The largest continuous level, in this part of the valley, has its centre in Sheffield, from which a branch extends S. W. along the E. side of Taconic Mountain, nearly to the Furnace Pond (Salisbury,) and another S. E. along the E. side of the Housatonic, connecting with the valleys in North and South Canaan. Between these two branches extends a series of Mica Slate ridges, continued N. from the ridge bounding the valley at Weed's Quarry (K1,) on the West, in a very undulating course, and marked by several transverse depressions, to a high isolated summit, adjoining the N. line of the State, E. of the North Ponds (Salisbury.) This range is chiefly composed of Mica Slate, in which the different varieties, already noticed, (namely, the light grey, the dark plumbaginous, and the coarse knotted varieties,) are distinctly marked. A lower isolated ridge (Rattlesnake Mountain,) extends through the W. part of the North Canaan valley, in a W. N. W. direction, nearly parallel to the N. front of Canaan Mountain. This consists chiefly of a light

grey quartzy Mica Slate, with subordinate beds of a dark bluish Mica Slate, with transverse flakes of mica. Large beds of a light grey Quartz rock, breaking in regular prismatic blocks, are included in the Limestone adjoining it on the N. E.; and smaller beds of a thinner, more fissile and mica seamed, darker grey Quartz rock, in the Mica Slate itself.

Hornblendic and Felspathic rocks are of rare occurrence within the limits of the present formation. At the N. E. point of the ridge, W. of the Housatonic, near the line of the State, beds of a dark bluish Hornblende occur, associated with a dark grey ferruginous Mica Slate, and accompanied with veins of smoky Quartz, and more rarely of a very hard bluish Felspathic Granite.

At some distance N. from the line of the State, the Limestone advances E., in a manner similar to its preceding advances in that direction, in North and South Canaan, and occupies a large tract in New Marlborough and Tyringham (Mass.,) within the limits of the Granitic formation (K2,) as already explained.

The present formation, considered as a whole, forms a long range, parallel to the preceding, curving to the East slightly, in the advances just referred to, in a manner conformable to the similar curves in the preceding ranges. It terminates on the S. abruptly, in the same manner as the Western branch of the Mica Slate formation (G3,) but perhaps traces of it may be observed farther S. W. along the interval between the Calciferous formation (H) and the Highland range (K3,) in like manner, as analogies to the Mica Slate of (G3) may be traced farther S. W. in connexion with the Western range (Third class) of (F.)

M. *A Micaceous Formation* (Mica Slate.)

This forms a narrow range, extending along the Western border of the preceding formation (L,) from its S. W. corner, between Carmel and Patterson (N. Y.,) at least as far North as the N. E. point of Taconic Mountain. At its Southern ex-

tremity, it forms a narrow band, interposed between the Limestone valley (L,) on the East, and the Granitic range of the Highlands (K3,) on the West. North of the termination of the latter, it expands to a greater width (1—2 miles,) and adjoins, on the West, an Argillitic formation (O,) to be afterwards noticed, as far N. as the West branch of Dover river, in Amenia (N. Y.) At this point, a Limestone valley (N) commences on the West, and farther N., separates the present formation from the Argillite (O.) Where this formation adjoins the Argillite, it generally forms a part of the same elevation with the latter, extending along the E. side of a high tabular ridge, interposed between the Dover valley, on the East, and the lower Limestone country of Dutchess (P,) on the West. Where it extends between the Dover valley (L,) and the Limestone valley (N,) it forms a narrow range of more or less detached elevations, or a low broken ridge, through the cross valleys of which, the level of the Dover valley communicates with that of the Limestone valley (N,) on the West; the main Eastern branch of Dover river passing through the largest of these, W. of Sharon. N. of the outlet of Indian Pond (Sharon,) the present formation rises to a higher, but still narrow ridge, continued N. to the great Ore Bed (Salisbury.) Here it again subsides, and then rises abruptly at the S. point of Taconic Mountain.

The predominant rock of this formation is a soft, light grey, coarse or fine-grained Micaceous, or Talco-Micaceous Schist, with garnets and staurotides. Sometimes it is greenish and subchloritic, with seams and patches of compact green chlorite, and yet accompanied with the same minerals. This is particularly the case, in the S. and N. E. parts of Taconic Mountain. The same greenish variety, with garnets, is found in the ridge, connected with the preceding formation (L,) West of the Housatonic, in Salisbury. Subordinate beds occur, more or less frequently, sometimes of large extent, of a darker or lighter blue, thicker Mica Slate, with transverse scales of mica, and of a black, thick, compact, highly pyritiferous variety, resembling

Argillite, particularly a similar variety of the latter, which will be noticed under the Argillitic formation (O.) Occasionally beds occur of a fine-grained, light blue, thick, sub-calcareous Mica Slate, similar to that in the range (G S. 3δ,) extending through Washington. Large and small veins of crystalline Quartz are generally frequent in the Mica Slate of this formation, particularly in the lighter grey coarser varieties; frequently accompanied with nests of compact chlorite, and more rarely, of bluish felspar.

The present formation is of great importance, as the principal depositary of the Hematite (iron) ores, in the N. W. part of this State, and the adjoining part of New York. It includes within its limits, the ore beds of Salisbury, Sharon and Dover; and indeed traces of the Hematite may be observed, more or less frequently, throughout the entire extent of the formation, from Patterson to Massachusetts. From the observations I have made, I have been led to believe, that the Hematite, like Bog ore, is of secondary formation, and is derived from the decomposition of the pyrites, contained in the Mica Slate of the formation, particularly in the black sub-argillitic variety, and in a less degree, in the dark blue variety with transverse mica. Seams of Hematite may not unfrequently be observed in these varieties of the Mica Slate, which are besides characterized by their dark red brown rusted surface. The ore beds themselves present usually a distinctly stratified arrangement, in parallel beds interposed between the strata of the undecomposed Mica Slate adjoining, and Quartz veins are also found in the ore beds, arranged precisely as they occur in the unaltered rock of this formation. The ore is accompanied with alternate layers of a yellow or reddish ochry earth, called Fuller's earth by the miners, derived apparently from the decomposition of the light grey Mica Slate of the formation, which corresponds, in this respect, with the light grey Mica Slate of the preceding formation, as already observed. The different results, from the decomposition of the different varieties of the Mica Slate, may perhaps depend on the peculiar composition

of each, or on the fact, that magnetic pyrites abounds more particularly in the darker varieties, and common pyrites in the lighter. The most important ore beds in Salisbury, namely, the Ore Hill, and Chatfield's, are situated on the E. side of the depression S. of Taconic Mountain; the others, in that town, along the E. base of that mountain, farther N. Indian Pond ore bed (Sharon,) is at the Western base of the ridge next S. of Taconic Mountain, towards its S. termination, and the Dover bed, on the Eastern declivity of the present formation, W. of Dover.

This formation extends only a short distance along the W. line of the State, namely, from W. of Sharon village, to its N. W. corner, being chiefly included within the limits of New York and Massachusetts. It might be considered an appendage of the preceding formation (L,) its rocks resembling nearly the Micaceous rocks of the latter, with some few characteristic differences. The great expansion of this formation, in Taconic Mountain, is opposite the enlargement of the preceding, in Salisbury and Canaan; thus showing a conformity of the two in their general arrangement.

N. *The Northeast Limestone Valley.*

This commences near the point, where the West branch of Dover river passes through the preceding Mica Slate range (M,) and extends Northward, between that range and the Argillitic range (O,) through Amenia and Northeast (N. Y.,) to Boston Corner (Mass.) It is there terminated, on the N., by a projection of Taconic Mountain to the W., in Mount Washington (Mass.,) but communicates on the N. W., by a cross valley, between the N. point of the Argillitic range (O) and the S. W. point of Mount Washington, with an extensive basin, in Copake (N. Y.,) belonging to the Blue Limestone formation (P.)

The Limestone of this valley is generally light blue or grey, rarely pure white, and is less crystalline and more compact than that of the Dover and Berkshire valley (L.) It usually breaks in square blocks or fragments, often very small. It

generally alternates with a dark-blue or blackish, coarse or fine-grained argillitic Mica Slate, or sub-micaceous Argillite, very commonly with transverse flakes of mica, resembling, in this respect, the rock, already noticed, at the junction of the Mica Slate formation (C) with the Argillite (B.) Quartz veins, sometimes dark grey or nearly black, occasionally occur in the Mica Slate. In the Eastern part of the valley, especially, large beds or subordinate ranges may be observed of a very dark blue or black, coarse or fine-grained, sub-argillitic schist, usually extremely pyritiferous, and resembling the rock of the preceding formation, which I have considered the depositary of Hematite. This includes smaller beds of a very dark micaceous limestone, also abounding in pyrites, sometimes in large nodules. The Mica Slate sometimes forms low ridges in the valley, particularly in the S. part of it; and a more elevated transverse ridge of the same crosses the valley, in a line about half way between Indian Pond (Sharon,) and the Ore Hill (Salisbury,) dividing the valley into two nearly equal parts, in the Northern of which, the limestone apparently predominates more than in the Southern. The Amenia ore bed (Hematite) is situated on the W. side of this valley, near its Southern extremity, in a hollow between the Argillitic range (O,) on the W., and a low ridge on the E., of a thin shelly, light bluish Slate, very nearly approaching Argillite in its character. The ore bed is apparently interstratified, in the manner already noticed under the preceding formation, and also includes portions of Slate and veins of Quartz in a position conformable to the structure of the rock adjoining. The present formation just touches the Western line of the State, from the S. front of Taconic Mountain, to a point W. of Sharon.

O. *An Argillitic Formation.*

Under this head, is included a range of Argillite and Talco-Chloritic Slate, occupying a high tabular ridge, extending along the W. side of the Mica Slate range (M,) and of the Northeast valley (N.,) apparently from a point N. W. of the

Northern termination of the Highland range (K3,) to the cross valley, connecting the Northeast valley with the Copake basin. This range is apparently widest at its Southern termination, narrows abruptly in Washington (N. Y.,) W. of Dover Plains, and then gradually diminishes in width to its Northern extremity.

The predominant rock of this range is a dark blue or black, thin shining Argillite, not unlike that of (B,) in which are included subordinate ranges of a thin, light greenish, or silvery grey Talco-Chloritic Slate. In the Southern wider portion of this range there are apparently different subordinate ranges of the Talco-Chloritic Slate; but in its Northern part, only one more extensive range, traversing it nearly centrally. The Talco-Chloritic Slate often abounds in irregular quartz veins, accompanied with nests of compact green chlorite, and with iron pyrites. From the decomposition of the latter, these veins are often cavernous; the cavities deeply stained purple. The Talcose Slate of the range, ordinarily of a light grey colour, is more or less deeply green and chloritic, adjoining the quartz veins. This association of ferruginous quartz veins with a grey Talcose slate, green and chloritic adjoining the veins, presents no slight analogy to the more usual rock in the Gold regions of the Southern States. Magnetic iron, in small octahedral crystals, is often disseminated in the Talco-Chloritic Slate of this range, particularly in a small isolated ridge of a deeper green, more chloritic variety, occurring near the Eastern border of the range, S. E. of Washington (N. Y.) The same mineral is occasionally observed in the Argillite. The Argillite, adjoining the Talco-Chloritic Slate, is often of a light grey colour, resembling the latter, but of a rougher feel, and more quartzose, somewhat resembling the light grey quartzose variety, accompanying the Argillite of (B.) Quartz veins abound in this variety, but nests of chlorite are very rare. Quartz veins are also not unfrequent in the darker varieties of the Argillite. I have observed limestone (the blue compact variety) only in one locality, in the interior of the present

range, namely, in a depression on its summit, W. of Northeast; but it occurs generally along its Western border. In the latter position, E. of Washington (N. Y.,) a peculiar variety of Argillite occurs, adjoining small subordinate beds of blue limestone; closely marked by very delicate transverse lines of a light grey tint, contrasting strongly with the deep blue of the Argillite, and evidently calcareous. These were apparently formed by a transverse segregation, at the original formation of the rock, and not by infiltration in seams, posterior to the consolidation of the latter. Beds, sometimes quite extensive, of a peculiar shining black, very ferruginous Argillite, usually thicker and more compact, occur in connexion with the common Argillite of the present range. These very nearly resemble the black variety of Mica Slate, in the two preceding ranges (M—N,) from the decomposition of which, I have supposed the Hematite to be derived. Like that, too, these beds are generally very deeply rusted on their surface, and sometimes present small seams of well marked Hematite. The Amenia ore bed, as already oberved, is on the Eastern border of the present range, and the Clove bed is probably within its limits. The Beekman ore bed is in the range (P,) next West.

North of the cross valley, connecting the Northeast valley (N) with the Copake basin, the present range is apparently continued in the Western ridge and central valley of Mt. Washington, in the Taconic range. The Taconic range, at its Southern extremity, East of the Northeast valley, forms a part of the Mica Slate range (M.) Farther North, in Mt. Washington, an elevated valley divides the range into two parallel ridges; namely, an Eastern, forming a continuation of the Mica Slate range (M,) and a Western, in the line of the Argillitic range (O.) The intervening valley is thus nearly in the line of the Northeast valley (N.) The predominant rock, in the Eastern ridge, is the light grey Mica Slate, with garnets, of (M,) more distinctly greenish or sub-chloritic, than in that range farther South. That of the valley, is a dark blue

sub-argillitic Mica Slate, often with transverse flakes of mica, with subordinate beds or layers of a darker more argillitic variety, particularly in the vicinity of Quartz veins. The rock of the valley rather resembles, in the whole, the Micaceous rocks of the Northeast valley (N,) than the Argillite of (O,) although not unfrequently varieties occur very similar to the latter. I have not noticed, however, any beds of limestone in the rocks of this valley. The Western ridge consists of an extensive range of a light greenish grey Talco-Chloritic Slate, with Quartz veins, accompanied with nests of Chlorite, and with magnetic iron disseminated, very similar to the Talco-Chloritic Slate of (O,) particularly that of the central range in the North part of the latter formation. Along the Western declivity of this ridge, extends a band of dark blue Argillite, connected with the blue limestone of (P.) From these observations, I have been induced to regard the Northern higher and wider part of the Taconic Mt. (in Massachusetts,) as formed by a union of the three ranges (M—N—O.) This view would seem to be farther confirmed by the fact, that in Gilder Hollow, a cove extending South from the Berkshire valley, towards the middle valley of Mt. Washington, between the N. point of the Eastern ridge of the latter, and its Western ridge (continued N. along the W. line of Massachusetts,) limestone again occurs, alternating with a blue sub-argillitic Mica Slate, frequently in the vicinity of the limestone, a well marked Argillite.

P. *A Formation of Blue Limestone and Argillite.*

This, the Western limit of my observations, extends along the Western border of the Primary, at least from Fishkill to Hinsdale (N. Y.,) and probably to a much greater distance. It consists, so far as I have observed it, of alternate ranges, sometimes of considerable width, of a dark or light blue compact Limestone and of Argillite. The limestone, like that of the Northeast valley (N,) generally breaks into jointed fragments. It is usually thick, but sometimes thin and schistose, and is then marked by a submicaceous silvery glazing, which

also occasionally occurs in the Argillite. I have not observed any organic remains in this formation, so far as I have examined it, though I directed my attention particularly to that object. The Argillite of this formation is usually softer and duller than that of (O,) and is more frequently intersected by transverse cleavages, which, as the schistose seams are rarely, if ever, consolidated, divide the rock into jointed fragments, sometimes very small. The Argillite sometimes includes subordinate beds or ranges of a light greenish grey quartzy Talco-Chloritic Slate, with quartz veins accompanied with chlorite; not unlike that of the preceding formation (O.) The Lead Mine of Ancram is situated in a large quartz vein, in such a range. The ore of the vein is chiefly galena, associated with other metallic sulphurets (those of copper, zinc and iron.) This formation, towards the South, in Fishkill and Beekman, adjoins the Granitic range of the Highlands, and farther North, the Argillitic range (O,) and the Western ridge of Taconic Mt. In its Southern part, adjoining the Highlands, the limestone apparently predominates much more than in its more Northern part, West of (O.)

The two last formations (O—P) lie entirely beyond the limits of this State, but from their importance in determining the general relations of the Western Primary System, I have been induced to examine them to some extent, though not as particularly as those within the limits of the State. The same reasons have led me to a similar examination of a small part of the Highland Granitic range (K 3,) and of those parts of the formations (H—K 2—L—M—N,) which lie contiguous to our Western border.

The five last formations (L—M—N—O—P,) taken together, may be considered as forming an extended range, enclosing the Northern termination of the Highland Granitic range (K 3,) and marked, particularly on its Eastern border, by a curve, with subordinate flexures, analogous to that of the more Eastern ranges. The range thus formed, presents throughout an alternation of more Calciferous formations (L—N—P,) and of

others (M—O,) almost entirely wanting in limestone. It also presents two parallel subordinate ranges, the Eastern of which, formed by (L—M,) is characterized by an alternation of Mica Slate with Limestone, and the Western, formed by (O—P,) by a similar alternation of Argillite with Limestone, while the formation (N,) included immediately between the most micaceous and most argillitic portions of the two lateral ranges, respectively, is characterized by a great predominance of limestone, and is apparently intermediate, in the character of its interposed rocks, between the adjoining Micaceous and Argillitic ranges. This range, and the one next East, formed by the union of (H) and (I,) taken together as a whole, form a still more extended range, with a similar curvature, including, in the interval between its two subordinate ranges, the series of isolated Granitic formations (K3—1—2,) which also form a range of conformable curvature. The different ranges, West of the series of Granitic formations (K3—1—2,) exhibit successively a less degree of curvature, as we proceed Westward; the flexures being most strongly marked on the Eastern border of the Calciferous formation (L,) and but slightly on the Eastern border of (M,) while the ranges farther W. (N—O—P,) extend nearly in a direct line N. N. E. The most Eastern ranges, in the Western Primary, (A—B—C—D,) also exhibit a similar regularity in their outline, extending nearly directly N. N. E. in their more Northern part, with a large but uniform curve Westward, towards their Southern termination. The Highland range (K3,) together with the Blue Limestone range (P,) curves distinctly to the West, in a similar manner, East of Fishkill; thus showing a general conformity in arrangement between the most Eastern and the most Western formations in the Western Primary. The comparative irregularity in the outline and distribution of the more central ranges of the Western Primary System, will be obvious, without farther explanation.

General Remarks on the Western Primary System.

From the preceding statements, it will be seen that the Western Primary System, viewed as a whole, presents a series of parallel ranges, first bearing N. Easterly, and then bending N., conformably, in the first instance, to the coast of the Sound, and in the latter, to the Western border of the larger Secondary formation; thus presenting a general curvature, with its convexity towards the East. Beyond the limits of the State, on the North, appearances also indicate that these ranges, at least those East of the series (K 1—2,) even bear around towards the West, so as still farther to complete their curvature. These ranges, taken in succession, from East to West, are the Chloritic range (A,) that formed by the combined Argillite and Mica Slate formations (B—C,) the Porphyritic range (D,) that formed by the union of the Micaceous formations (E—G) and the more granitic range (F,) that formed by the combined Calciferous and Micaceous formations (H—I,) the Granitic series (K 3—1—2,) and that formed by the combined Micaceous and Argillitic Calciferous formations (L—M—N—O—P.)

Besides the general curve, above specified, these ranges present a series of flexures, in their N. Easterly direction, each of which may be traced, more or less distinctly, through the whole; thus indicating that they were controlled in their arrangement by a common influence. Without noticing, at present, those of less importance, we may observe, in following the course of these ranges, two of greater extent, which may be clearly traced through the entire series. The ranges, adjoining the Sound, namely, (A, C—B, D, E, F,) as has been already stated in the particular account of those formations, first bear E. N. E., nearly in a line parallel to the coast. This bearing is, however, observed very slightly in (C—B.) The range of (H) also pursues that course, to the point where it turns N. between Danbury and Brookfield, and the same direction may be observed in the course of the Granitic series, through (K 3) to the S. point of (K 1,) or rather, perhaps, to a point in (K 3,) W. N. W. of the Southern termination of the

Dover valley, where it bears to the West, as already noticed, East of Fishkill. The most Western range (P) conforms, of course, to the direction of the latter. Advancing farther in the general N. Eastern direction of the different ranges, we observe distinctly, in the more Eastern ranges, a general change in bearing to the N. N. E.; namely, in the Northern part of the Chloritic range (A,) in the S. half of the range formed by (B—C,) and in the Porphyritic range (D,) from near Bridgeport to the S. front of Beacon Mountain. The range formed by (E—F—G,) exhibits the same change of direction, on its Eastern border, in the interval between Trumbull and Beacon Mountain, and on its Western border, in that between the N.W. corner of Reading and New Preston. This change in the direction of the range (H—I) is observed, on its Western border, in the interval between the S. E. corner of the Dover valley (L) and the Northern termination of the Kent Limestone valley (H2ε.) On the Western border of the Granitic series (K 3—1—2,) it is observed in the interval between the South point of Schaghticoke Mountain and Lime Rock (Salisbury,) from which latter point the Limestone valley (L) extends Eastward into South Canaan Hollow. The same direction (N.N.E.) is observed in the corresponding portion of all the more Western ranges.

At Beacon Mountain, the Micaceous formation (E) makes a remarkable bend, nearly East. This bend affects the ranges (D) and (C—B) on the S. E., more slightly, however, as will be observed by referring to the map accompanying this Report, and may even be traced in the sudden bend to the East, at the N. point of the Chloritic range (A.) This flexure is observable on the Western border of the range (E—F—G,) in the long interval, along the Western border of (G,) from New Preston to the Naugatuck, at Wolcottville. The corresponding flexure, on the Western border of (I,) occupies the interval from South Cornwall to the S. point of the valley of Still river, near Wolcottville, while that on the W. border of the Granitic series (K 3—1—2,) extends from Lime Rock to the head of

North Canaan Hollow. From the E. point of Beacon Mountain, the formation (E) again assumes a N. N. Easterly direction, alike observable in the Northern part of the two ranges parallel to it on the East (D) and (C—B.) The same Northern direction is assumed in all the more Western ranges; at first N. Easterly, namely, on the Western border of (G,) from Wolcottville to the E. branch of Farmington river; on that of (I 2,) from near the same point, along the valley of Still river, to a point near the N. line of the State; and on that of (K 2,) if we do not take into account the Limestone district, included in that formation, from the head of North Canaan Hollow, to a point in New Marlborough (Mass.) At each of these latter points, respectively, the Western border of those ranges bears more directly North. The Eastern border of the range (E,) continued in (G,) also bears more directly North, at the point where it meets the larger Secondary basin, North of the N. point of (D,) and perhaps the same direction would be assumed by the ranges (D—C—B—A,) farther East, if continued through the country occupied by the Secondary. This is apparently confirmed by the relation of the Argillite (B) to the Argillite in Bernardston (Mass.,) afterwards referred to. The second Eastern flexure may be traced, though less distinctly, in the Micaceous range (M,) at the S. point of Taconic Mountain, and a corresponding slight flexure may be observed in the valley and Western ridge of the latter, in Mount Washington; thus indicating its extension even to the Western border of the Primary.

The lines connecting the points of flexure present a singular change in direction, as we proceed Northward. That connecting the first points of flexure, from near Bridgeport, through Reading, to the S. point of the Dover valley, bears more directly N. W.; that connecting the second points of flexure, from the N. W. point of Beacon Mountain, through New Preston, to Salisbury, bears more N. N. W.; and that connecting the third, from the E. point of Beacon Mountain, by Wolcottville, to the head of North Canaan Hollow, bears still more Northerly. The flexures are much more strongly marked

in the central, than in the more lateral ranges. This is particularly remarkable in the second Eastern flexure in the ranges (E—F—G, H—I, K,) compared with that in the more Western range (L,) and especially with that in the more Eastern ranges (D, C—B, A.)

Viewed in another relation, the Western Primary System presents analogies no less striking. Its central portion exhibits a series of Granitic and Micaceous alternations, which partly appear as alternate parallel bands, partly as isolated nuclei, generally granitic, around which the more micaceous formations are, in a manner, concentrically arranged. On the Eastern and Western borders, a singular analogy may be observed. In the three most Eastern formations (A—B—C,) the following order occurs in proceeding from the centre outwards; namely, Mica Slate, Argillite, Chlorite Slate. In the most Western formations (M—N—O—P,) not including the limestone, we observe essentially the same order, namely, Mica Slate, Argillite, Talco-Chloritic Slate, Argillite. The Chlorite Slate, on the East, is not included, as a subordinate range, in the Argillite, in the same manner as the Talco-Chloritic Slate on the West; but it passes into the Argillite by a gradation analogous to that connecting the Talco-Chloritic Slate with the Western Argillite. The Chlorite Slate of (A) has, however, if I may so express myself, a more decidedly primary character, particularly in its connexion with Hornblende and Felspar, in its beds and ranges of Greenstone; perhaps derivable from its relation to the Granitic formation (A,) terminating at the S. W. corner of the Eastern Primary System. This subject will be farther considered in connexion with the Eastern System. The Western formations, above alluded to, form the frontier of the Western Primary System, towards the great Secondary basin of the Western States. From analogy, we may regard the three Eastern formations (A—B—C,) as a corresponding frontier of the Western Primary, in that direction. This is rendered more probable by the fact, that at the Northern extremity of the larger Secondary forma-

tion, in Bernardston (Mass.,) there is a range of Argillite, extending North, apparently between the continuations of the Eastern and Western Primary Systems.

I have remarked above, that the different formations, particularly in the more central ranges, occur either in alternate bands, or in isolated points or nuclei. Strictly speaking, however, even the more elongated formations are isolated and detached, so that the whole Primary System might be considered as a group of more rounded or more elongated detached formations. Not unfrequently in ledges of no great extent, an analogous arrangement may be observed, apparently indicating that the stratified or parallel Primary rocks were not formed by an uniform mechanical deposition, but by a segregative process, by which, within certain circumscribed limits, rocks were formed of a particular composition or structure. In reviewing the Western Primary, the isolated character of most of the formations will be obvious, even in the more elongated. Thus the band of blue fine-grained Mica Slate, in (G S. 3 δ,) may be traced distinctly throughout a long narrow range from the East part of New Milford, to the North part of Canton, but at those points the range is apparently terminated. Remarkable examples of distinctly isolated or circumscribed formations, may be observed in the Granitic formation (K 1;) the Red Porphyritic range (H 2 α;) the Granitic basins, connected with (G N.;) the Porphyritic formations, connected with (F,) particularly those of Greenwich (1,) of Wilton (4,) and of Brookfield (7;) and still more, that connected with (G,) West of Litchfield, (G S. 3 ζ.) These are, for the most part, entirely disconnected with any similar formation, by the interposition of formations of a very different character, while the arrangement of the strata is such as to render it altogether improbable that this separation has arisen from any removal of the rock of these isolated formations in the space intervening. In some instances, however, narrow ranges of similar or allied rock may be traced between these detached formations, analogous to the narrow veins or seams which sometimes connect

similarly circumscribed beds of Granite. Thus the narrow range, extending through Plymouth, containing beds or subordinate ranges of Granitic Gneiss, associated with porphyritic veined Gneiss and Limestone, apparently connects the Bristol Granitic basin with the range (F,) or the Granitic formation (G S. 2,) and the band of sub-porphyritic rock, traversing (F 5,) in Reading, also apparently connects the Porphyritic range of Wilton (F 4) with that of Newtown (F 6 β,) and perhaps with (F 7.)

An important feature in the Western Primary System, is the change in the character of the formations in the same ranges, along a transverse line, crossing the System, in an undulating course, nearly E. S. E. This is marked by the line separating the formations (H) and (I,) by that separating (F) and (G,) and in the range formed by (F) and (E,) more especially by the transverse series of Porphyritic formations, crossing the former (F,) namely, that of Brookfield (F 7,) and particularly those of Newtown and Monroe (F 6 β—α,) and by the tract of porphyritic veined rock (β 13,) between Monroe and Huntington, nearly interrupting the course of the Micaceous rock (α,) in the latter (E.) It is worthy of remark, that the Housatonic crosses the different ranges from the East side of (K 1) to (C 4,) nearly in the line marked by this transverse change in the character of the formations. But the formations thus interrupting each other in the line of their direction, do not usually terminate abruptly, but send processes into each other, running out at a greater or less distance, as has been already observed at the line of junction of (H) and (I,) and at that of (F 2) and (F 6 α,) between Monroe and Weston. At other times, the peculiar rocks of a formation may terminate abruptly, but after a considerable interval, a subordinate range may occur in the interrupting formation, analogous to some part of that interrupted. Thus the rock of the range (β,) on the East border of (F 5,) has often a near resemblance to that of (G S. 3 β,) on the East

border of the Mica Slate formation, West of the Secondary basin in Woodbury.

The different formations, in the same ranges, on the opposite sides of this transverse line, present certain striking contrasts, which may be here slightly referred to. Thus the range formed by the two formations (F) and (G,) is characterized, on the South side of this transverse line, in (F,) by a predominance of Felspar, and on the North side, in (G,) by a predominance of Mica and Quartz. The felspathic rocks in the former (F,) are more generally finer grained and more parallel (gneissoid,) and more frequently form extensive tracts or ranges; in the latter (G,) they more usually occur as included beds in the more micaceous rocks, and are generally coarse-grained, and less distinctly parallel, though most frequently interposed in the direction of the including rock. The porphyritic rocks of that range are also, for the most part, on the South side of that transverse line. The range formed by the two formations (H) and (I,) is nearly equally micaceous, on both sides of this tranverse line, and the felspathic rocks, in both formations, have on the whole a similar arrangement and character; but the formation (H,) on the South, is characterized by the comparative abundance of its limestone, while the formation (I,) on the North, is almost entirely destitute of it. The limestone of the formation (L) also begins, on the South, at a point not far South of the same transverse line.

The arrangement of the Porphyritic rocks, in the formations West of (E,) has apparently a remarkable relation to this transverse line. The extensive Porphyritic ranges, in Monroe and Newtown, (F 6 α—β,) extend along the South side of this line, while the Porphyritic range (F 7) extends North, from the West point of (6 β,) along the Western border of (G,) and is succeeded, after successive interruptions, on the Western border of the same formation (G,) by the similar Porphyritic ranges (G S. 3ζ—δ;) the entire series curving round the S. W. point of (G,) and then extending N. Easterly, along its W.

border. The subordinate Porphyritic ranges (γ—β—α,) in (F 2,) again extend in a line S. W. from the S. E. part of (F 6,) along the E. border of (F,) while the series of Porphyritic ranges (F 1—4—5 δ,) parallel to the latter, on the West, approaches the series (F 6—7,) at the point where it bends Northerly along the W. border of (G.) The Red Porphyritic range of Shelt Rock (H 2 α,) which may be considered as continued S. W., in a line nearly parallel to the two preceding series (F 2 γ—β—α) and (F 5 δ—4—1,) by the porphyritic rocks connected with the Limestone valley (H 1 †,) and the Porphyritic range (H 1 α,) has already been described as extending in a direction N. N. W., nearly parallel to the Western border of (G,) near the S. W. termination of the latter, and as apparently continued, after a considerable interruption, in the Red Porphyritic range (α,) at the S. E. point of the Granitic formation (K 1;) thus connecting with the interrupted Granitic series (K 1—2,) which forms, in like manner with the series (G S. 3 ζ—δ,) a range nearly parallel to the Western border of (G.) The Granitic range of the Highlands (K 3,) apparently extending S. Westerly, in a direction nearly parallel to the series (F 5 δ—4—1,) approaches the series (H 2 α—K 1—K 2,) in nearly the same manner as the series (F 1—4—5 δ) approaches the series (F 6—7, G S. 3 ζ—δ.) The direction of the sub-granitic range (H 2 γ^1,) with its included Granitic range (††,) first N. N. W. and then bearing N. N. E., nearly parallel to (H 2 α) and its continuation in (K 1 α,) is here worthy of notice; and if we consider the Granitic range (††) as connected with the Granitic ranges, subordinate to (I 1—2,) which it resembles somewhat in the structure and still more in the albitic composition of its rocks, it will present, with the latter, another series, extending, in a general direction, parallel to the Western border of (G.)

The Limestone ranges, West of (E,) also present a similar relation to this transverse line. The limestone of (H,) as already noticed, terminates abruptly at the Southern border of (I,) sending out a process, however, on the West, along the

West border of (I,)* in a relative position to the latter, similar to that of (F 7) to (G.) The main body of the limestone recedes still farther West, to the formation (L,) when it extends N. N. Easterly, in an undulating course, successively advancing to the East, in a general direction, parallel to the more Eastern ranges. The Eastern frontier of the Western Limestone series may, however, be traced from the head of the Kent valley, through Cornwall Hollow, till it unites with the limestone of (L,) at the head of South Canaan Hollow.

The range formed by (E,) continued in (G 1 S. N.,) presents a similar arrangement, in relation to this transverse line; extending first N. Easterly in (E,) in a direction parallel to the series (F 2 α—β—γ,) (F 1—4—5 δ,) and the others noticed farther West, and then expanding West around the Northern termination of (F 8,) in (G S. 1,) whence it extends N. E. and N. in a direction conformable to that of the more Western ranges. The apparent N. Western direction of the Western borders of (G) and (I 2,) towards the North, would seem to indicate that those formations inclose the Granitic formation (K 2,) on the North, in the same manner that (E,) continued in (G S. 1,) surrounds (F 8,) in the same direction. The formations (D, C—B, A,) parallel to (E,) on the East, follow the direction of the latter to their termination on the W. border of the larger Secondary basin, and perhaps, if continued, would, in like manner, extend to the West, at some point farther North, within the present limits of the Secondary. The subordinate beds and ranges of limestone, connected with the different ranges, East of (F) and (G 3,) namely, (E, C—B, A,) not including the more granitic Porphyritic range (D,) indicate, though in a much less degree, a predominance of that rock towards the Eastern border of the Western Primary, analogous to that observed towards its Western border.

* The Kent Limestone valley (H 2 s.)

The Eastern Primary System.

This occupies all that part of the State East of the larger Secondary formation, and extends North and East, into Massachusetts and Rhode Island. It is bounded South by the Sound, and West by the Eastern border of the Secondary formation, in a line drawn N. Easterly from Morris' Cove (New Haven Harbour,) to the Connecticut river, below Middletown, (or more strictly to a point East of Durham village,) and thence more Northerly, to the N. line of the State, in Somers. I begin with the more detailed account of the individual formations, composing the System, in the same manner as in the Western Primary, reserving my more general remarks on the arrangement of the whole, to the conclusion.

A. *A Granitic Formation* (Gneiss.)

This forms a very extended range, which may be traced along the coast, from the Light House (East Haven,) on the E. side of the entrance of New Haven Harbour, into Rhode Island, and thence Northerly, along the Eastern border of the State, into Massachusetts. Throughout this extensive range, there appears such a general uniformity of character in the rocks composing it, as to entitle it to be considered a distinct and connected formation. In that part of the range West of Connecticut river, its limits are more indistinctly marked; some of the formations, lying farther West in the System, apparently commencing in it, or in connexion with it, in a manner which will be better explained, when I come to treat of them separately. East of the Connecticut, however, its Western frontier is marked very distinctly.

The most characteristic rock, in this formation, is a Granitic rock (Gneiss,) with more or less of red felspar in its composition; varying from a rock almost entirely red felspathic, to one in which only a few grains of red felspar are disseminated. Associated with this, are rocks, in which white felspar predominates; others, marked by parallel seams of dark mica,

forming a sub-granitic Gneiss, usually with white felspar; and occasionally, subordinate beds or ranges of dark Micaceous Gneiss. This formation also includes several subordinate ranges of a peculiar character, which will be afterwards more particularly specified.

The Western border of this formation may be traced in the following manner. Commencing at Morris' Cove, on the East side of New Haven Harbour, it follows the line of the larger Secondary formation, to a valley, N. of Branford village, through which flows a small stream, from the ponds in North Branford to Branford creek. It then extends E. N. Easterly, along a valley, parallel to the New Haven and Guilford road, on the North. The precise boundary of the formation, from that valley to the vicinity of Guilford borough, on the West, I have not ascertained; two or three narrow formations, hereafter specified, apparently commencing at a point in this interval. This formation occupies, however, the neck of land (Sachem's Head,) W. of the mouth of Guilford river, and is there, in its progress East, apparently interrupted. It then reappears again, at Clinton borough; its strata first ranging North Easterly, and East of the borough, bearing South Easterly, till it meets the Sound, West of the Menunkatesuck. It again appears in low ridges, in the plain West of Saybrook village, bearing E. N. Easterly, till its Western border approaches the Connecticut, not far North of Lyme Ferry. This latter then bears N. N. Westerly, conformably to the course of the river, and apparently in an irregular line, to the West side of the ridge of Mt. Archer, in the vicinity of Brockway's Ferry (Hadlyme.) The border of the formation, thus far, presents a very undulating outline, in a general direction, nearly East, to the mouth of Connecticut river, and then bearing North, as above specified. In this part of its course, too, it apparently suffers two interruptions; but as I have not explored the coast of the State, along the immediate water line, it may perhaps be traced there throughout the entire distance. From the point, above noticed, East of Connecticut river, it extends first N. Easterly, along the W. side of Mount Archer,

and then more E. N. Easterly, through the S. E. corner of East Haddam, and the centre of Salem, to Gardner's Pond.* It is then directed in a nearly E. S. E. course along a high ridge on the Northern border of Montville, to the Thames, on the S. side of Trading Cove, below Norwich. East of the Thames, it bears more Easterly, to the North point of Lantern Hill, near the line of North Stonington and Ledyard. It then curves N. Easterly, around an isolated Hornblendic formation (F 3 α—β,) afterwards noticed, to the Southern extremity of an extensive basin, E. of Griswold. From this point it extends N. by E., in a nearly straight line, E. of Plainfield and Westfield (Killingly,) to the valley of Five Mile river, along the E. side of which it is continued, in nearly the same direction, to near the N. E. corner of the State. It then extends along the E. side of the Great Oxford Pond, to a point between Webster and Oxford (Mass.,) and again bears E. N. Easterly, nearly in the line of the Middle Boston Turnpike, passing just South of West Sutton village, to the road from Sutton to Douglass, by the Manchaug Factories. At this point (the limit of my observations,) it apparently bears again S. Easterly, leaving Sutton village on the North.

Along nearly the whole of this extensive frontier, East of the Connecticut, this formation presents a high ridge or escarpment, towards the country on the North and West, bordered immediately in that direction, by a well marked valley or plain. From the Connecticut to the S. point of the Griswold basin, a very distinct valley or depression can be traced along the North side of this frontier, particularly remarkable in Salem, and W. of Trading Cove. From the Griswold basin, Northwards, it adjoins the valleys of the Quinebaug and Five Mile river, and N. of the latter, in Massachusetts, a similar depression can be traced, as far as my observa-

* A more Western boundary might be assigned to the present formation, from a point N. of Saybrook village, near the Haddam Turnpike, to Salem, marked by a formation of fine-grained Micaceous Gneiss (E 1.) This boundary will be afterwards more particularly pointed out, in connexion with the range (B*,) referred to under (3 ^{3}) of the present formation.

tions have extended. Thoughout the greater part of this distance, too, this frontier is marked by a band of a reddish fine-grained very felspathic rock, preserving, through its whole extent, a singular uniformity.

Viewing this frontier as a whole, without taking into account its lesser undulations, it presents four remarkable flexures. It first bears Easterly, from the S. W. point of the Eastern Primary, to near the mouth of Connecticut river; then Northerly, for a comparatively short distance, to Mount Archer; then Easterly, to Lantern Hill; then N. N. Easterly, to Webster (Mass.;) and then again Easterly, passing through the S. part of Sutton (Mass.) Its general direction to Lantern Hill, it will be observed, is nearly parallel to the coast of the Sound, and thence to Webster, nearly parallel to the E. coast of Massachusetts, or rather to the W. coast of Narragansett Bay, and the Western border of the Secondary formation in Rhode Island. It has already been shown, in the account of the Western Primary, that the formations, there, bear W. at their Southern termination, conformably to the direction of the coast. The same conformity, in bearing, is thus continued along the whole coast of the State.

In so extensive a formation as this, it would be difficult to present its more detailed features, distinctly, in one view. I shall, therefore, proceed to describe it more particularly, under its local subdivisions, beginning at its S. W. extremity.

1. Under this head, is included the section, extending along the coast, from the Light House Point (East Haven,) to Sachem's Head, on the W. side of Guilford Harbour; thus forming a narrow range, of a somewhat semi-elliptical outline, interposed between the Sound and the Northern border of the formation. The surface of this section presents a series of low ridges, in which the strata are directed, in the Western part, E. N. Easterly, and in the Eastern part, S. Easterly. The predominant rock is a thick even felspathic Granitic Gneiss, with both white and red felspar; partly with white, and partly with dark mica; the latter most frequent, and generally ac-

companying the red felspar. The rock, throughout the greater part of the section, is almost entirely granitic, with only a few thin seams or isolated patches of a dark micaceous gneiss interposed; the latter often exhibiting an arrangement, similar to that of the granitic seams and nodules, interposed in the more micaceous rocks. Occasionally small beds occur of a dark Hornblende, with a dark micaceous gneiss adjoining. Both the Hornblende and Micaceous Gneiss, in such cases, are usually fine-grained, with a peculiar uniform rounded sub-porphyritic structure, generally characteristic of the Eastern Primary. Veins of a reddish felspathic granite often accompany such localities. Occasionally beds of a coarser sub-porphyritic dark Hornblende occur in connexion with the more granitic rocks of the section; sometimes traversed by parallel veins of white granite, with lateral seams of hornblende, and with detached crystals of hornblende disseminated. In that part of the section, between Branford and Guilford, already noticed, (††) there occur, along the coast, E. of Stony Creek, and farther N. W., at the S. W. point of the high ridge of Moose Hill, subordinate beds or small ranges of a dark micaceous or submicaceous Gneiss, more or less sub-hornblendic, and with occasional beds of Hornblende, apparently indicating the commencement of a series of narrow formations farther N. E. (B 2—4,) already alluded to. The Granitic rock of the present section is generally very felspathic, but distinctly parallel in its structure; often so, when very coarse-grained, and with the more obvious characters of a coarse granite. It is generally of a medial grain; rarely fine-grained. A porphyritic structure is sometimes distinctly observable, both in the coarser and finer varieties.

The S. W. part of this section, in East Haven, forms a range (α,) chiefly occupied by a Granitic Gneiss of a subreddish tint, with occasional beds of a full red interposed, and usually with parallel seams of a shining black mica. This rock is generally very ferruginous, with reddish brown stains, and blue or purple seams. This ferruginous tint is very dif-

ferent from the reddish tint of the felspar, and occasionally gives its red colour to the rock, when very little red felspar is present. This range (α) extends Easterly through Branford village. West of that village, on the Western border of the Primary, commences a range (β) of a white or very light grey Granitic Gneiss, chiefly composed of white felspar, with seams of white, and more rarely of dark mica. Occasionally thin interposed bands occur of a coarser or finer dark green (sub-chloritic) Micaceous Gneiss, accompanied, particularly when coarser grained, with small parallel porphyritic veins of a bluish quartz, and intersected by cross seams of a dark green chlorite. Small detached points of a similar dark green chlorite are also occasionally disseminated in the granitic rock of this range. The latter rock is sometimes very decomposable, often with ferruginous seams, and with a greenish tint diffused through the whole (from the sulphate of iron.) This range (β) extends along the Northern border of the section, at least to a point East of Branford creek. South East of Branford village, a range (γ,) characterized by a coarse white felspathic variety, with occasional white talcose seams, extends along the East side of Branford creek. In the S. E. part of this section, at Sachem's Head, (δ,) a reddish felspathic variety, similar to that of the range (α,) generally predominates. The range (††,) above noticed, characterized by frequent beds of Micaceous Gneiss, with Hornblende, is apparently interposed between the two latter ranges (γ—δ.)

Beds or veins of coarse Granite, generally interposed, occasionally occur throughout this section, particularly along the Western border of the Primary, in (α) and (β,) and in the range (γ,) East of Branford creek. The Granite, along the immediate Western border, is of a peculiar character, apparently indurated, and very prismatic, with frequent veins of Quartz. In the range (α,) this Granite is usually dark grey, with a greenish tint (sub-chloritic,) with darker bluish Quartz veins. In the range (β,) it is of a lighter grey, sometimes even white, with a fainter bluish or pure white Quartz in

veins. Sometimes geodes of a limpid crystalline Quartz occur in these veins. In a locality, S. of East Haven, in the range (α,) occurs a bed of a very peculiar granitic rock, with a fine-grained light greenish or dark purple ground; the latter, particularly, much intersected with small veins and patches of crystalline quartz, and apparently resembling some of the varieties of indurated Sandstone, adjoining Trap. This latter variety is also traversed by seams of specular iron, like a rock, not unlike it, accompanying the copper veins in Manchester and Vernon, noticed under (C 1.) The rock, in the present instance, is distinctly parallel in its structure, and is rather a modified variety of the Granitic Gneiss of the formation, than a Granite. The Granite of the range (γ) is usually very white felspathic and sub-talcose, conformably to the general character of the range. Frequent beds or veins of a coarse reddish felspathic Granite occur in connexion with the dark Micaceous Gneiss, in the range (††.)

The Granitic Gneiss along the immediate Western border of the Primary, as well as the included Granite, is generally very hard and prismatic, particularly in the range (α,) where it often assumes the dark greenish grey tint of the coarser Granite, accompanying it, and like that, too, is intersected with frequent Quartz veins. This frontier rock, at the S. W. termination of the present section, near Morris' Cove (New Haven Harbour,) is generally finer grained, and with a less distinctly parallel structure, than the Granitic Gneiss more remote from the frontier. It is also less mica seamed and schistose, and appears at first sight as a uniform fine-grained unstratified Granite, yet on closer examination a parallel structure, precisely analogous to that of the more gneissoid rock, farther in the interior of the present section, is distinctly obvious. By tracing the rock from the frontier into the interior, it will be found to graduate in less than half a mile into a distinctly parallel dark mica seamed Gneiss, scarcely less felspathic, however, than that on the immediate frontier. The rock, in

the latter position, is generally much indurated, and breaks in small jointed fragments, as already noticed, and is occasionally nearly filled with small parallel or obliquely transverse veins or patches of a bluish Quartz. The prismatic cleavages, even in the interior of this part of the present section, are often marked by thin seams of a dark green compact chlorite, and occasionally thin parallel seams of a similar kind occur near the frontier, with minute crystals of quartz and felspar, arranged conformably to the structure of the rock. The strata in the present section, particularly in its more Western ranges (α—β—γ,) generally dip slightly N., and are occasionally undulating, so as to present no distinct dip in any direction. The coarser Granite veins, as well as the larger Quartz veins, are apparently interposed in the general direction of the strata, usually, however, with a more or less oblique position, corresponding to the general arrangement of interposed veins, as well as of the porphyritic structure. These veins, too, are usually detached and interrupted, forming apparently more or less elongated nodules or segregations, in the including rock.

The South Eastern Trap Dike, in the Eastern Primary, commences in the present section, on the shore at Branford Point, and extends across it N. Easterly, near the line of Branford creek.

2. The section, at Clinton, apparently consists of a single broad low ridge, generally of a coarse reddish felspathic Granitic Gneiss, more or less seamed with dark mica, with alternate bands of a finer, lighter grey, sub-granitic gneiss, (with frequent small parallel veins of reddish granite,) and of a dark micaceous decomposable gneiss. The rock of this section is generally very ferruginous, with red or yellow stains, like that of (α) and (δ,) in the preceding section. Interposed beds or veins of coarse red felspathic Granite are not unfrequent in this section. On its Northern border, the rock generally presents thin alternate bands of a finer grained reddish felspathic, and light grey sub-granitic Gneiss, with interposed bands or veins of a coarse or fine red felspar Granite, and with occa-

sional beds of a dark micaceous sub-hornblendic Gneiss, and more rarely of Hornblende. Adjoining this section on its Northern border, N. E. of Clinton borough, is a narrow range of a fine-grained, light grey, decomposable sub-micaceous Gneiss, with minute scales of plumbago disseminated, and accompanied with veins of coarse white Granite. The direction of the strata, in this section, is E. N. E. in its Western part, at Clinton borough, and E. S. E. in its Eastern part. South of it, an alluvial plain extends to the coast.

3. Under this head, is included all that portion of the present formation (A,) lying farther East, including the low ledges of reddish Granitic Gneiss, in the plain, West of Connecticut river, in Saybrook. The whole of the great extent, thus included, forms one connected formation, in which many obvious distinctions may be observed, but which, at the same time, presents a sufficiently well marked uniformity of character.

The most characteristic rock of the entire range, is a rather coarse-grained, thick-bedded Granitic Gneiss, or parallel Granite (α,) arranged in large interposed beds or subordinate ranges, alternating with rocks of a less granitic character. The structure or grain of the rock is distinctly stratified or parallel, not only in its seams or flakes of mica, but in the arrangement of its quartz and felspar. This arrangement is usually distinctly porphyritic veined, or veined porphyritic, particularly in relation to the quartz; giving to the rock an appearance strikingly peculiar, as obvious in Douglass, on the N. E., as in Lyme, at the S. W. extremity of the present section. This rock generally contains more or less of a red or reddish felspar; varying from a dark red, verging on purple, to a faint sub-reddish white. Occasionally, however, varieties occur, of a very pure white felspar. Generally the proportion of mica in this rock is very small, occasionally almost wanting. That of quartz is generally least in the more red felspathic varieties. Veins of crystalline quartz, often very transparent and limpid, are of not unfrequent occurrence in

this rock, varying from an interposed to a nearly directly transverse position. In these veins, even when most directly transverse, small detached points of felspar may be observed, precisely similar to that of the general mass, and arranged in the direction of the stratification or parallelism of the rock, apparently indicating that these veins were of cotemporary formation with the rock itself, and controlled by the same influence.

Another variety of granitic rock (β,) already referred to, may be regarded as characteristic of the Western frontier of the formation, though a similar rock is occasionally found within its interior. This is a very fine-grained, more or less uniform, red or reddish felspathic rock; varying from a full red to a very light sub-reddish grey, verging on white. In a large part of the frontier band, already noticed, this rock is distinctly stratified, with very even seams or small alternate stripes of a fine light grey sub-micaceous gneiss, as observed above, on the Northern border of section (2.) Occasionally, however, beds occur, of a very fine, uniform, nearly compact grain, still more purely felspathic. Large beds of this kind are met with in the frontier range, East of Griswold, and smaller beds, resembling interposed granite veins, very frequently occur along the frontier, and in various points in the interior, particularly in the vicinity of the Mystic, in Groton and Stonington. This rock, especially the latter kind, usually breaks in large or small, very regular jointed fragments. Occasionally, also, small beds of a dark micaceous gneiss occur in connexion with this rock, in the frontier range; one of which was observed in that part of it N. of Montville, closely resembling the dark micaceous rock of the formation (F 2,) there adjoining it on the North.

Under a third head (γ,) may be comprehended a series of less granitic, more mica seamed rocks, forming alternate beds, connected more particularly with the first variety (α,) or more or less extensive subordinate ranges. This rock consists of thicker, generally even granitic stripes or layers, with white felspar,

alternating with thinner seams of dark mica. It is darker or lighter grey, from the greater or less proportion of the micaceous seams to the granitic layers; passing on the one side into a dark grey sub-micaceous gneiss, and on the other into a nearly uniform granitic gneiss, or parallel granite. These varieties often occur alternately in the same locality. This rock is more fissile, and usually more decomposable than that of the first class (α.) Some of its ranges are, indeed, highly decomposable and ferruginous; disintegrating to a considerable depth from the surface, into a granitic gravel. In some of the larger ranges of this class, large beds of coarse white granite are not unfrequent, also occasionally veins of quartz, and beds of dark micaceous gneiss and hornblende; the latter resembling those already noticed in connexion with the section (1.) Large interposed beds sometimes occur of a rather fine-grained light grey granitic rock, uniform in structure, and with little appearance of parallel arrangement, forming a fine-grained granite, perhaps better suited for purposes of architecture than any other within the limits of the State. The quarry at Millstone Point (Waterford,) is in a large bed of such a fine-grained grey granite, included between the strata of a light grey, dark mica seamed, rather coarse-grained granitic gneiss. Veins of coarse granite and crystalline quartz, as well as small beds of hornblende, and others almost entirely composed of a rather coarse black mica, often occur in the immediate vicinity of these larger granitic beds, as in the locality just mentioned. In some of the ranges of this class garnets occur, both in the more granitic beds and in the darker more micaceous alternations.

The granitic rocks of this formation rarely exhibit a distinct porphyritic structure. Several ranges, however, occur, of a well marked porphyritic granitic gneiss (δ,) both with red and white felspar. These rocks differ from those of the first class (α,) not only by their more distinct porphyritic structure, but by their stronger seams of dark mica, resembling more, in that respect, the rocks of the third class (γ.) Their mica seams

are, however, generally less even and more interrupted than those in the latter. Sometimes the mica of these rocks is nearly uniformly disseminated in a rather fine-grained sub-porphyritic ground. Some of the ranges of this class are highly decomposable into a granitic gravel, as has been noticed in relation to certain ranges in the preceding class.

A series of peculiar ranges of dark Micaceous Gneiss (ε,) generally quite narrow, may be traced throughout a large part of the formation. The mica of these ranges is generally of a deep black, occasionally with a soft talcy lustre. In a series of these ranges, extending through the North part of Waterford, and through Groton, ($^{7}\dagger\dagger$,) the rock is often marked by small interposed patches of a white silky fibrous Talc, often extremely delicate and beautiful. These micaceous ranges are more or less accompanied with larger and smaller veins and patches of crystalline quartz, and with beds of a light grey sub-micaceous Quartz rock; also with beds or veins of coarse white Granite, and of a finer grained, very slightly felspathic quartzy Granite, and with beds and patches of dark hornblende, and occasional patches of green pyroxene and of epidote. In one of these ranges, E. of Milltown (North Stonington,) I noticed small beds of a light green pyroxenic limestone. Garnets are occasionally disseminated in the different rocks of these ranges, particularly the more micaceous.

Another very important series of ranges of a light grey Quartz rock (ζ,) occurs in the N. Eastern part of the formation. Slighter traces of a similar Quartz rock occur in the more S. Western part of the formation, in Montville, and a large interposed bed or vein of white crystalline quartz may be traced apparently a considerable distance from West to East, through the S. E. part of Salem. The ranges of Quartz rock, in the N. Eastern part of the formation, have apparently an important relation with some of the dark Micaceous ranges, already alluded to, which are themselves accompanied, more or less, with beds of a grey sub-micaceous Quartz rock, somewhat similar to that of the Quartz ranges. These latter are accompa-

nied, particularly on their sides, with bands of a darker grey more micaceous quartz, and with others of a dark or light grey micaceous rock, more or less abounding in seams and small parallel veins or patches of crystalline quartz, and often in nodules of epidote. These Quartz ranges are generally bordered by parallel beds or ranges of a fine-grained Granitic Gneiss, either uniformly red felspathic, or thin even striped, light grey and reddish, closely resembling the rocks of the class (β,) on the Western border of the formation. The most important and extensive of these Quartz ranges extend from the North of Plainfield through Killingly. A more particular description of these, as well as of other local ranges, will be given, when I come to present a more detailed account of the present section.

Magnetic iron, disseminated in nodules and grains, may be considered as characteristic of the present as well as the two preceding sections of this formation, particularly of the more granitic rocks. It is usually most abundant, and in larger nodules, in those which abound most in red felspar. The black sand, so frequent along the coast, throughout the whole extent of the formation, is doubtless derived from this source. Although so frequent in a disseminated state, I know of no large veins of this ore, within the limits of the present formation.

The general direction of the strata, as well as of the different ranges in the present section, corresponds to that of its Western border, already described. Thus, in the S. part of Lyme, nearly throughout the entire interval from the Connecticut to the Niantic, this direction is Northerly. In the N. part of that town, it bears round to the E., and then pursues an undulating Easterly course, to the point near Lantern Hill, where the Western border of the formation bears N.; though more remote from the frontier of the formation, this Easterly course is continued to the East line of the State. The undulations in the direction are apparently most strongly marked at the greatest distance from the frontier, particularly towards the West, adjoining the Niantic, where the direction on the West,

in Lyme, is generally N. N. E., and on the East, in Waterford, S. S. E.; while nearer the frontier, and even at an equal distance from it, farther East, as in Stonington, the direction generally changes from E. N. E. to E. S. E. In that part of the formation, along the Eastern border of the State, where the Western frontier is directed Northerly, the direction of the strata and ranges corresponds to that of the frontier to a certain distance from the latter, but more remote from it, the direction often changes, in a singular manner, from a North-Eastern course, on the West, to an undulating Easterly course (E. N. E.—E. S. E.,) and then to a S. Easterly course, farther East; apparently indicating a circular or concentric arrangement. At the point, S. of Sutton, where the frontier of the formation again bears Easterly, there is a corresponding change in the direction of the strata. The direction of the interior arrangement of the formation is most distinctly indicated by that of its subordinate ranges, particularly its dark Micaceous and Quartz ranges. These latter are comparatively long and narrow, and can be often distinctly traced to a great distance in the line of direction. Still they are apparently more or less subject to interruptions and lateral shifts in their progress, conformably, as I conceive, to the general arrangement of the Primary ranges. In the more granitic portions of the formation, this interrupted and isolated arrangement of the subordinate parts, is apparently still more strongly marked; but in the present report, I shall not attempt to lay it down in its more minute details. It may, however, be made, in some degree, obvious, in the more particular account of the present section. The prevailing dip, throughout the whole extent of the present formation, is Northerly, or towards and underlying the more Western formations. As the direction pursues, generally, an undulating course, particularly where it is more Easterly, as in sections (1—2,) and in the S. Western part of section (3,) varying from N. N. E. to E. nearly, and again to S. S. E., the dip varies, in a corresponding manner, from W. N. W. to N., and then to E. N. E.; generally larger, where

more nearly N. or S., and often nearly horizontal, where more nearly East.

1. Commencing on the S. W., a range of considerable extent, including the S. part of that portion of the present section, West of Connecticut river, in Saybrook, occupies the S. W. part of Lyme, at least as far N. as the basin of Rogers' Pond. This is characterized by a predominance of red felspathic rocks, referable to the two first classes (α—β,) above mentioned. On the Western border of this range, a finer grained reddish and light grey striped Granitic Gneiss, similar to that on the N. border of section (2,) already noticed, forms the predominant rock in a ridge, extending N. from the Lyme Ferry, along the E. side of the Connecticut. It includes, not unfrequently, parallel beds of a fine-grained uniform red felspathic rock, with little appearance of parallelism in its structure, and also beds or veins of a coarse red felspar granite. It alternates occasionally, particularly on its Western border, with a dark mica-seamed sub-granitic gneiss (class γ,) which sometimes includes, in its mica seams, detached flakes of hornblende. That portion of this range, W. of the Connecticut, in Saybrook, belongs to the present sub-division. The greater portion of the range, on the E., consists of a coarser grained reddish Granitic rock, not unlike that of (α) and (δ,) section (1,) in Branford and Guilford, and of the main part of section (2,) at Clinton. It includes beds or veins of coarse red Granite, and alternates with a coarser or finer grained dark mica-seamed Gneiss (class γ.) The beds or veins of granite are generally interposed, and sometimes include thin parallel bands or detached and often contorted patches of gneiss, usually darker and more micaceous than the rock inclosing the granite. The dark mica-seamed gneiss often forms small subordinate ranges, and is accompanied with interposed veins or nests of white and sometimes red granite, and also of crystalline quartz, and occasionally with beds of black or dark green hornblende; the latter occasionally with small veins of white granite, with disseminated hornblende. In some instances, the dark mica-

seamed gneiss is apparently sub-talcose; the mica seams having a soft silky lustre, and marked with delicate fibres, as in a similar rock accompanying the Micaceous ranges (7††.) The reddish felspathic rock of this part of the range is generally very decomposable and ferruginous, accompanied with the same ferruginous stains, as the corresponding rock in sections (1—2.)

2. West of the preceding range, occurs another of nearly equal width, commencing on the W. side of the Connecticut below Essex, and passing thence N. Easterly through North Lyme, at least to the vicinity of Grassy Hill. The predominant rock in this range is the dark mica-seamed sub-granitic gneiss of class (γ_1) occasionally sub-hornblendic, as noticed on the Western border of the preceding range. This rock occasionally passes into a nearly white fine-grained felspathic gneiss, sometimes forming large included beds. Beds of reddish granitic rock are comparatively rare in this range. Beds or veins of coarse white granite are more frequent. These beds are generally interposed, and have sometimes a distinctly porphyritic structure; nodules of a sub-reddish felspar being included in a finer whiter felspathic ground. Parallel seams of a coarse dark mica or micaceous gneiss are occasionally included, usually more or less detached and contorted, as already noticed in the granite of range (1.) Occasional alternations occur of a dark Micaceous Gneiss, at times sub-hornblendic, and at other times with garnets disseminated, and not unfrequently abounding in small veins of white Granite, sometimes also with disseminated points of hornblende.

3. Farther N. W. occurs a parallel range, (including the high ridge of Mount Archer,) extending N. Easterly between North Lyme and Hadlyme, and thence more Easterly through the S. part of Salem. This range is characterized by a greater prevalence of reddish granitic rock (class α_1) than in the preceding, but at the same time, presents more frequent alternations of the dark mica-seamed rock of class (γ_1) than occur in the first range (1.) The more granitic rocks of this range, like those of the range (1_1) are are often decomposable and ferrugi-

nous stained. Generally they are much divided by jointed seams, and occasionally, when more red felspathic, break in very small fragments. The dark mica-seamed rocks of this range, like those of the preceding, are occasionally sub-hornblendic, and beds also occur of a dark hornblende; sometimes coarser and sub-micaceous, with small veins and porphyritic points of white felspar, and with seams of crystalline hornblende; and at other times fine-grained and ferruginous. Along the N. Western border of this range, in the ridge of Mount Archer, and in a low ridge, farther N. E., West of the valley of Hamburgh river, extends a subordinate range, characterized by beds of the fine-grained reddish felspathic rock of class (β.) Farther S. E. in the range, a series of beds of coarse white granite, with interposed veins and patches of crystalline quartz, may be traced through a part of this range, as at the N. point of Mount Archer, and farther East, in the S. W. part of Salem. The large vein of crystalline Quartz, in the S. E. part of Salem, already alluded to, is in nearly the same line of direction, farther E. In the S. part of Mt. Archer is a subordinate range of a reddish porphyritic gneiss (class δ.) The characteristic rock of this range is a thick bedded granitic red porphyritic rock, with a finer sub-porphyritic and rather darker mica flaked ground, alternating with a rather coarser and lighter uniform sub-porphyritic, and a still lighter white or reddish porphyritic veined granitic gneiss; the latter variety not a little resembling the more granitic porphyritic veined rocks, alternating with the large porphyritic rock of (D 1 W.,) East of Huntington. Beds of coarse red granite also occur in this range, with a distinctly veined porphyritic structure; its porphyritic points of red felspar being compounded, like those in the porphyritic rocks of the Western Primary, with lines of quartz often separating the distinct crystals. Porphyritic nodules or detached nests of a fine-grained bluish crystalline quartz are also found in this granite. A porphyritic rock, similar to that in Mount Archer, occurs in a ridge, on the opposite (West) side of Connecticut river, in a S. W.

direction, in which the fine-grained reddish felspathic rock (β) may also be traced. The present range may be thus considered as commencing, like the preceding, on the W. side of that river, but at a point apparently farther North. Farther N. W. than the present, extends a parallel range of dark mica-seamed sub-granitic Gneiss (*,) similar to that of class (γ,) but which, from its peculiar relations, I shall defer to a subsequent part of the report (B4.)

4. East of the first range (1) in the present section, another range, of moderate width, extends along the W. side of the valley of Four Mile river (Lyme,) characterized by a dark mica-seamed Gneiss (γ,) accompanied with alternations of a darker, more micaceous Gneiss, and with large beds or veins of coarse white Granite. Garnets are not unfrequently disseminated through the different rocks of this range, from the darker more micaceous beds, to the coarsest grained granite. The rocks of this range are generally, also, very decomposable. Towards the Southern extremity of this range, adjoining the old road from Lyme to New London, beds of red granite occur in connexion with a dark mica-seamed gneiss, with garnets. The granite is generally coarse-grained, with large patches of fine red graphic granite, and with parallel interrupted seams or patches of coarse black mica. In the vicinity of one of these beds, large crystallized and massive garnets are included in a vein of quartz, with scapolite and green pyroxene adjoining, (the last with garnets.) Beds of a dark coarsely crystalline Hornblende also occur, with nests of pyroxene and epidote, and with small veins of white felspar granite. The present range is apparently continued N. Easterly, between Grassy Hill and East Lyme, into Chesterfield, where it is connected with a remarkable Quartziferous range ($^{7}\dagger$,) to be afterwards noticed. N. W. of the line of the present range, thus continued, at the head of the valley of Four Mile river, East of Grassy Hill, is a range of small extent, characterized by a reddish porphyritic rock (δ,) similar to that at the South end of Mount Archer, noticed under the preceding range (^{3}.)

5. Farther East, a wider range extends N. between the valleys of Four Mile and Mamacock rivers (Lyme,) and then more N. Easterly, at least to the Head of Niantic (Waterford.) This is characterized by a predominance of the thick bedded granitic rock of class (α,) generally with more or less of red felspar, but occasionally very white felspathic. Dark mica-seamed alternations are occasionally met with, in which veins of coarse granite occur more frequently than in the predominant rock of the range. Nests or isolated veins of crystalline quartz, sometimes with detached points of reddish felspar, arranged as already noticed in the more general account of the rocks of class (α,) are not unfrequently observed in the latter. The granitic rock of this range is generally coarser grained and less ferruginous and decomposable than that of the Eastern part of range (1,) and is characterized by a greater proportion of quartz, and by that peculiar porphyritic veined arrangement of the latter, noticed under class (α,) generally observed in the more thick bedded varieties farther N. E. in the present section. At the Head of Niantic, this rock is very red felspathic; generally coarse-grained, but not unsuited for building. S. W. of this latter point, a small subordinate range occurs of a dark mica-seamed, white felspathic Gneiss, with garnets, not unlike that of range (4.)

6. East of the latter range (5,) occurs another extensive range, apparently occupying the ridge between the Mamacock and the Niantic, and also the greater part of Waterford and New London, and extending into the S. W. part of Groton. This is characterized by a dark mica-seamed, usually white felspathic, more or less granitic Gneiss (class γ,) presenting the peculiar characters of that class more strictly than perhaps that of any other range in the whole formation. It is not unfrequently accompanied with alternate bands of dark micaceous Gneiss, and occasionally with beds of dark schistose Hornblende. These occur more particularly in the vicinity of the more granitic beds included in the present range, where are also observed thin bands almost entirely composed of a rather

coarse decomposable black mica, and others of a similarly decomposable and coarsely crystalline sub-micaceous Hornblende. Beds, just alluded to, are occasionally met with, composed of a fine-grained light grey, more rarely reddish, very felspathic Granitic rock, apparently quite regularly interposed between the strata, but with little appearance of parallelism in its structure, as at the Quarry at Millstone Point (Waterford.) The bed at this Quarry is interposed between the dark mica-seamed gneiss of the present range, in a S. E. direction, with an obvious dip to the East. The central part of the bed is usually very uniform in its grain, but in the lateral portions small parallel bands or veins occur of a coarser white or reddish granite, and in the adjoining gneiss, small nests and veins of a still coarser red and white granite, the last with greenish mica. Dark micaceous and hornblendic bands, such as have been just noticed, also occur in the gneiss immediately adjoining the granitic bed. Small detached parallel portions of the same gneiss are observed in the lateral portions of the bed, as if segregated in the granite. The rock of this Quarry is divided by nearly horizontal rather undulating seams, obliquely transverse to its dip, and is thus easily quarried by gadding it vertically. Minute grains of pyrites are disseminated in this rock, which give an iron stain, by their decomposition, to that part of it adjoining the cleavage seams, called *sap* by the workmen. The dark mica-seamed gneiss of that part of the present range, extending through the S. part of Groton, is occasionally traversed by cross seams of epidote.

The ranges, thus far described, lie in that part of the formation, where the direction is more Northerly, with a bearing to the East of North (N. N. E.—N. E.) on the West of the Niantic, and to the West of North (S. S. E.—S. E.) East of the same. The five first ranges may be regarded as continued in that part of the formation, extending through Montville, Groton and Ledyard; but I have not been able to trace them there with sufficient distinctness, to enable me to discriminate them as in that

part of the present section already described.* The last range (6) apparently recurs again in Stonington, E. of Porterville, and extends through that town, to the vicinity of Paucatuck village.

7. Under this head, is included that part of the formation, already alluded to, extending through Montville, Groton and Ledyard, into the contiguous parts of Stonington and North Stonington. This division also includes the S. E. part of Salem, and an angle in the S. part of Bozrah, on the North, and the N. part of Waterford and New London, on the South. It also embraces that part of the frontier range of fine reddish felspathic gneiss (β,) extending from Salem to Lantern Hill, near the line of Ledyard and North Stonington. Exclusive of this frontier range, the predominant or most characteristic rock, throughout this division, is the thick bedded granitic rock (α.) This varies from a full red, to a very light grey, or nearly white, with only a few grains of red felspar disseminated. The most usual variety, however, is sub-reddish, with rather a predominance of white felspar, and with a considerable proportion of quartz disseminated, in the peculiar manner, already noticed, in the more general account of the present section. The Granitic rock (α,) in this division, presents its peculiar characters, in a very perfect manner, but still with a close resemblance to the same rock, in the most North-Eastern part of the formation, which I have examined (in Douglass and Sutton.) Alternate beds and subordinate ranges not unfrequently occur of the dark mica-seamed sub-granitic rock of class (γ,) with occasional darker more micaceous alternations, sometimes accompanied with Hornblende; but the subordinate ranges of this class are not so strongly marked as to

* The ranges, already noticed, are perhaps interrupted in their progress N. E. and E., and succeeded by other ranges of a different character, while ranges of a similar character may be found replacing them, but in a different line of direction. This tendency to interruptions and lateral shifts is quite obvious in some parts of both the Eastern and Western Primary, and is apparently characteristic of the interior arrangement of the present formation.

enable me to lay them down at present, with any precision. There occur, however, within the present limits, several ranges, generally long and narrow, of dark Micaceous Gneiss (class ε,) each presenting a peculiar character, but with some common traits of resemblance. These, with a few others of a more specific kind, will be afterwards more particularly enumerated.

The Granitic Gneiss (α) of this division is generally subject to ferruginous stains, as in the preceding ranges, but is usually less decomposable. Magnetic iron is very commonly disseminated through this rock, but its ferruginous character is rather derived from the presence of minute pyrites. This has given a stain to the rock, to a certain distance from its seams, forming a discoloured band, called the *sap*, by the quarrymen; already noticed in the Granitic rock of Millstone Point, Waterford. The rock of different localities is subject, in different degrees, to this stain; giving a great advantage to those quarries, which are comparatively free from it. Not unfrequently, the Granitic rock of this division, from its thickness and grain, is well fitted for quarrying, but as its structure is generally distinctly parallel, and its grain rather coarse, it is but ill suited for the nicer purposes of architecture. This rock is quarried in several places in the vicinity of the Thames and the Mystic, as well as at some points, more remote from those rivers. The two leading varieties of this rock, are the reddish grey, and sub-reddish white, both of which are generally coarse-grained. Beds of both of these kinds sometimes occur in the same vicinity, but more generally they occupy distinct subordinate ranges. The former (deeper red) variety apparently predominates in a range extending through the Southern part of this division, in the contiguous parts of Waterford and Montville, and in Groton. This variety, even when coarser grained, is usually more uniformly felspathic than the sub-reddish variety, and with less of the porphyritic veined quartz, characteristic of the present class (α.) Its structure too is usually less parallel, and less distinctly marked by seams or

flakes of mica. The felspar of the coarser kinds often has a strong purplish tint, frequently observed too in the larger porphyritic nodules of felspar in the coarse red Granite of the present formation, as in that accompanying the porphyritic rock of Mt. Archer, in range (3.) Beds, rarely of great extent, occur in some parts of this range, particularly in the vicinity of the Mystic, of a fine-grained felspathic rock, of a very uniform grain, varying from a full red to a faint sub-reddish white or light grey; similar to that of the frontier range (β,) already noticed. These beds are occasionally quarried, but are sometimes too much divided by jointed cleavages to be worked to advantage. The latter (sub-reddish) variety is more frequent in the central and Northern part of this division, in Montville and Ledyard, where, however, ranges of the former (red) variety occasionally occur, as in a very rocky ridge, N. E. of Gale's Ferry (Ledyard.) The sub-reddish variety, particularly when coarser grained, is usually more distinctly parallel, and more strongly mica-seamed, than the former variety, and with a greater proportion of quartz in its composition; the latter often exhibiting very strikingly the peculiar porphyritic veined arrangement, already referred to. The finer grained rock of this variety is generally more purely white felspathic, and with a more uniform grain, and is sometimes well suited for architecture. Stoddard's Quarry, on the East side of the Thames, farther N. than the ridge last mentioned, and but a short distance S. of the Micaceous range (†,) is in a large bed of this variety, with a distinctly marked grain, in an E. S. E. direction, and with a medial dip N., and like that at the quarry at Millstone Point (6,) intersected by nearly horizontal obliquely transverse cleavages. The rock is there partly coarser grained and more uneven; partly finer grained, more uniform, and better suited for working. In both instances, it is accompanied with small irregular veins and nests of coarse and fine red and white granite and grey quartz, and with small interposed patches of fine-grained dark micaceous gneiss.

The frontier range of fine-grained reddish felspathic rock (β,) is generally well marked, along the whole extent of this division, from Salem to Lantern Hill, and is continued still farther N. E. to the N. point of a ridge, terminating N. W. of Wyasup Pond (North Stonington.) It forms throughout a long even ridge, with occasional transverse interruptions; first, bearing N. Easterly to a point East of Gardner's Pond; then E. S. E. to the Thames, below Trading Cove; then more Easterly, to Lantern Hill; and then N. Easterly, in the ridge, terminating as above noticed. The prevailing rock in this range, is a light reddish grey, very fine-grained and even Granitic Gneiss, with alternate stripes, more reddish felspathic, and light grey sub-micaceous, generally breaking into larger flat blocks, by very regular cleavages, but occasionally into very small jointed fragments. Beds occasionally occur of a very uniform reddish felspathic variety, which usually breaks into smaller fragments, than the variety last mentioned. In the Western part of this range, extending from the S. part of Salem village to the S. W. point of Gardner's Pond, the rock is often highly ferruginous, with dark purple seams, and sometimes with a dark purplish tint throughout, appearing as if it had been subjected to the action of violent heat. The rock, too, in such cases, is generally very prismatic. Iron pyrites is sometimes found disseminated there in large nodules, and occasionally the rock is traversed by greenish, apparently chloritic seams. This frontier range (β) commences, towards the West, in a point, apparently detached from the main body of the present formation, by a narrow band, terminating the range (*,) noticed in connection with the range (^{3},) on the N. East, but nearly in the line of the same frontier rock, on the W. border of (^{3},) farther S. West.

The most remarkable ranges, traversing the present division, are those of dark Micaceous Gneiss (class ε,) already alluded to. These may be arranged under three distinct heads, forming apparently, from the line of direction of the subordinate parts, three distinct leading ranges.

The first of these ranges (†) may apparently be traced from a ridge, W. of the Niantic valley, at Chesterfield meeting-house, in an undulating course, E. N. Easterly, to the East side of the Thames, at Stoddard's Ferry (Ledyard.) This, however, is probably subject to interruptions and shifts in its course, some of which I have satisfactorily determined. I first noticed it, in a narrow ridge, on the road leading W. from Chesterfield to Grassy Hill (Lyme,) where its direction was N. N. E., but soon curved round to the East towards Chesterfield meeting-house. This ridge is apparently in the direction of the range (⁴,) in Lyme, continued N. E. I then traced it along the road, leading from Chesterfield to Montville, nearly to the road, leading by the Baptist meeting-house, in the S. part of Montville. I next observed it at a mill S. of Montville meeting-house, on the stream passing by Uncasville, and again on the Norwich and New London Turnpike, N. of Uncasville, at the Eastern termination of Horton's Mountain, a high ridge, bearing Easterly, along which it is apparently continued between the two last mentioned localities. From the point, last noticed, on the New London Turnpike, to that part of the range at Stoddard's Ferry, there is a considerable interruption and shift to the North, and at the same time, a distinct change in the character of the component rocks. The range may thus be considered as divided into two sections, the Eastern of which, at Stoddard's Ferry, commences on the West of the Thames, and has been traced by me, in a nearly E.—W. direction, less than half a mile on either side of the river.

In the Western part of the present range (†,) namely, to the point above noticed, on the New London turnpike, there is a smaller proportion of dark Micaceous Gneiss, and a larger proportion of a lighter grey thin sub-micaceous Gneiss, and of a light grey sub-micaceous Quartz rock. Both the dark micaceous and lighter sub-micaceous gneiss often abound in small veins and nests of quartz and white granite, adjoining which, particularly those of quartz, are frequently patches of dark green crystalline hornblende. Small beds of hornblende are

occasionally observed, particularly in the Eastern part of the range, at Stoddard's Ferry. The light grey gneiss, in the Western part of the range, sometimes abounds in a minutely disseminated, light green spicular Hornblende. A variety of this latter rock occurs at the point on the New London and Norwich Turnpike, very decomposable and ferruginous, and abounding in minute scales of plumbago. The quartz rock of this range often contains more or less of minute, and occasionally coarser white felspar disseminated; and in different points in the range, there occur beds or veins of a moderately coarse granite, if it may be so called, consisting chiefly of quartz and mica, usually with a very small proportion of white felspar. This is most frequent in the Western termination of the range, West of Chesterfield. Beds or veins of coarse white felspathic granite are common throughout the range. In the Western part of it, this occasionally contains nodules of quartz filled with seams of a delicate white fibrous mineral (Talc,) which sometimes also occurs in parallel seams in the more granitic and micaceous rocks of the range. The Eastern part of the present range, on both sides of the Thames, abounds more in dark Micaceous Gneiss than the Western. This is often sub-hornblendic, with seams and porphyritic points or patches of hornblende, and is generally more or less accompanied with small porphyritic veins of red and white granite and of quartz, adjoining which are often observed patches of black and dark green hornblende, and more rarely of light green pyroxene. Larger veins of coarse red and white granite also occur, and on the E. side of the Thames, was observed a bed of a fine-grained sub-porphyritic white granite, with a structure somewhat resembling that of the Mosaic Granite accompanying (C 4 W.,) consisting chiefly of a bluish white felspar, opaque white on its weathered surface, and a bluish grey quartz, nearly equally disseminated, with only a few flakes of dark mica, but sometimes with delicate fibrous seams of white Talc, similar to those already noticed.

Another range (‡) may be traced in nearly an Easterly direction, across a considerable part of Groton, nearly in the line of the Mystic Turnpike. It appears first at the gate, W. of Groton Centre, and again at a short distance East of the latter point, whence it may be traced along the turnpike, nearly a mile Eastward. This range very much resembles the preceding, in the character of its rocks, containing like that alternations of dark micaceous and light grey gneiss; the former particularly much veined with quartz and felspar, and subhornblendic, and also with beds of dark green hornblende, sub-micaceous quartz, and white granite. The Eastern section of this range, like that in the preceding, abounds more in dark micaceous gneiss and hornblende; the latter often occurring in large isolated patches, particularly adjoining the quartz and granite veins. Veins of the quartzy-micaceous granite, noticed in the preceding, are also observed in the present range, especially in its Eastern section, adjoining the Mystic Turnpike.

A third range (††) may apparently be traced, in an Easterly direction, through the S. part of the present division, from the N. W. corner of Waterford, to the S. E. part of Groton. This has been already alluded to, as characterized by its interposed seams or patches of a delicate fibrous white mineral (Talc.) These generally occur quite detached, in a parallel or interposed position, and are often finely radiated, forming a striking contrast with the dark micaceous ground of the rock. Nodules of bluish quartz, filled with similar white fibrous seams, also occur in the rocks of this range, as well as in those of that first mentioned (†.) This range is apparently less continuous, than the two preceding; being rather marked by a series of detached beds, along a certain line, generally in connexion with the range of reddish granitic gneiss, along the S. border of the present division. These beds, like the preceding Micaceous ranges, usually present alternations of light grey, dark-seamed sub-granitic gneiss, and dark micaceous gneiss, with the usual accompaniments of quartz and granite veins

and hornblende. Garnets are not unfrequent in the rocks of this range. The dark micaceous gneiss is generally coarse-grained and abounding in quartz and granite veins; but occasionally beds occur of a fine-grained thick uniform dark micaceous rock, abounding particularly in radiated patches of the fibrous mineral, above noticed. Fine specimens of this rock were observed, in a section of this range, West of Wightman's Cove (Waterford.)

On the summit of a high ridge, in Montville, (N. W. of the meeting-house,) extends a narrow range or bed of a light grey thick uniform quartz rock, breaking in regular blocks, quite similar to the thicker varieties of quartz rock in the Western range in Killingly (Q 3,) and in a line farther S., a range of beds of coarse white felspathic granite. These two ranges are apparently in the general line of direction, Easterly, of the beds of white granite, and the vein of crystalline quartz, noticed in connexion with the range (3.) This direction conforms to the general Easterly direction of the formation in that vicinity.

A remarkable Quartziferous range (1,) of little apparent width, may be traced, in an Easterly direction, for a considerable distance, across the S. part of Ledyard. Two points were noticed by me, in the range, West of the valley of the Pequonock. The more Western of these presented a large band of grey sub-micaceous quartz rock, with a few sub-porphyritic points of felspar, traversed by a large interposed bed of coarse white parallel granite with garnets, and bordered by a fine-grained, light grey, quartz-veined, sub-micaceous, very decomposable gneiss. In its less immediate vicinity, occurred a reddish grey granitic gneiss, with alternations of a darker sub-hornblendic (Sienitic) gneiss. The more Eastern of these points, immediately adjoining the valley of the Pequonock on the West, presented a larger bed of a coarse grey crystalline quartz rock, also with minute sub-porphyritic felspar disseminated, and with small veins of limpid quartz, bordered by a reddish grey granitic gneiss, abounding in seams of quartz, immediately adjoining the bed, and with a large vein, more

remote, of white quartz with larger porphyritic points of felspar. In a direction nearly East, two other points occur, on opposite sides of the valley of a stream, flowing S. E. to the Mystic. These very closely resemble each other, in the character of their rocks; consisting of a large bed, or subordinate range of a very coarse grey micaceous quartzy rock, of obviously parallel structure, with hornblende and epidote disseminated in grains and patches, and with veins of crystalline quartz and coarse red and white granite, bordered by a reddish felspathic gneiss, also with veins of quartz and similar granite.

These dark micaceous and quartziferous ranges are generally bordered by a more felspathic, usually reddish granitic gneiss, apparently indicating a peculiar tendency to segregation, along the line of their direction; the mica and quartz being chiefly concentrated in these ranges, and the felspar in the adjoining granitic gneiss. The association of hornblende and more rarely pyroxene, and of coarse red and white granite veins, with these micaceous ranges, is also worthy of notice. The latter are comparatively rare in the more granitic ranges.

8. Under this head, is included that part of the present section, extending through Stonington and the S. part of North Stonington. The N. W. part of the former town, adjoining the Mystic, is occupied by a continuation of the reddish granitic gneiss (α) of Groton, with beds of the fine-grained uniform felspathic rock, already noticed in that connexion. Fine specimens of this latter rock occur in the vicinity of Upper Mystic, and in the valley of the Quiambaug, on the Paucatuck Turnpike. The greater part of the same town, on the S. and S. E., is occupied by a range ($\dagger_7$) resembling that of Waterford (^{6}) of which it may be considered a continuation; the general bearing in the range (^{6}) being S. E. to E. S. E., and in the present range, E. N. Easterly. This range, like that of Waterford, is characterized by a dark mica-seamed subgranitic gneiss (γ_7) which in a part of the range greatly predominates, and in other parts includes, in greater or less

proportion, subordinate beds of reddish granitic gneiss (α.) A subordinate range, in which the dark mica-seamed gneiss predominates, extends from a point East of Lower Mystic, E. N. E. by the Baptist meeting-house on the Paucatuck Turnpike, apparently to the vicinity of the quarry, West of Paucatuck village. The rock of this range is occasionally sub-hornblendic, and includes alternate beds of dark micaceous gneiss and hornblende, and also beds or veins of coarse granite, usually with white, but sometimes with red felspar, and at other times with points of light red felspar, disseminated in a ground of pure white (albitic) felspar. Another subordinate range, farther S., extending along the base of the hills, N. of Stonington borough, includes frequent beds, sometimes very large, of reddish granitic gneiss, both coarse-grained, darker reddish grey, or reddish white, and fine-grained uniformly red felspathic. In a line farther North, on the West side of the road from Stonington borough to Paucatuck village, is a band of a fine-grained, even, dark green micaceous, or lighter green sub-granitic Gneiss, apparently subchloritic, with disseminated reddish felspar, and with fine longitudinal, slightly oblique stripes or seams of light red felspar; the latter, obviously formed cotemporaneously by segregation. This rock is traversed by longitudinal beds or veins of a coarse or fine bright red felspathic granite, distinctly parallel in its structure. Both the gneiss and granite of this band, particularly the latter, break in small prismatic fragments, occasionally with cross seams of epidote. Farther West, on the West side of the Quiambaug, and in nearly the same line of direction, occurs a band of a similar greenish sub-granitic gneiss, with red felspathic granitic alternations; the latter particularly with sub-porphyritic points of hornblende. The mica in these localities has a peculiar soft talcy lustre, most remarkable in connexion with the deeper red felspar. In the lower grounds, N. of Stonington borough, the dark mica-seamed granitic gneiss predominates, with not unfrequent smaller beds of reddish fine-grained granitic gneiss, and

veins of coarse red granite. Alternate beds of dark micaceous gneiss and hornblende are not unusual.

In a line North of the range (†,) on both sides of the Paucatuck, above the village of that name, occurs a range (‡) of comparatively little width, consisting for the most part, of a thick reddish grey granitic gneiss, generally of a moderately coarse grain, and composed chiefly of a dark red or purplish felspar. This rock, in its structure, not a little resembles that of Millstone Point (in range 6,) presenting little appearance of parallelism in its grain, and like that rock is well adapted for purposes of architecture. It traverses the ridge N. E. of Paucatuck village in Rhode Island, where it has been quarried, to a considerable extent, in the vicinity of the Rail Road, and has been used in the construction of the viaduct, and for other purposes in that vicinity.

Still farther North, a range (††,) of much more considerable width, extends E. N. E. through the contiguous parts of Stonington and North Stonington, and thence through the S. E. part of the latter town into Hopkinton (R. I.) This is characterized by a fine-grained, light grey, thin, even sub-granitic gneiss, with alternations of a darker more micaceous gneiss, and occasional beds of a coarse, nearly white granitic gneiss or parallel granite. All the rocks of this range are extremely decomposable, so much so that entire ledges are rarely seen on the surface. In a line farther North, apparently adjoining the West part of this range, a tract of reddish white Granitic Gneiss, highly decomposable and ferruginous, occurs West of Milltown (North Stonington.) This rock is generally very much stained, red and yellow, with blue and purple seams, as has been already noticed in some of the more Western divisions of the present formation, and not unfrequently decomposes on the surface into a kind of granitic gravel. It is apparently in the line of a range (*c* †,) farther N. E., noticed under the next section (9.) On the Southern border of the range (††,) adjoining the valley of the Paucatuck, in the S. E. corner of North Stonington, is a range of no great width, of a reddish

reddish grey thick Granitic Gneiss, including ... subordinate range or bed, resembling in its characters the Micaceous Quartziferous range (k,) in the South of Ledyard, noticed in the preceding section (7.) This consists of alternate ... light or dark grey, coarse and fine, slightly sub-foliated Quartz rock, and a dark micaceous gneiss, both of which abound more or less in small veins of crystalline quartz ... coarse and fine white granite, with patches of hornblende ... pyroxene, particularly in the dark micaceous gneiss. At a point towards the Eastern extremity of this range, thin granitic bands occur, more or less abounding in light green pyroxene, and bordered immediately by a coarsely crystalline black hornblende. Larger beds or veins of white Granite also occur, in connexion with this range; sometimes with a fine distinctly parallel felspathic ground, in which are included large veined porphyritic points of white felspar. A similar Micaceous Quartziferous range occurs not far North of Hopkinton village, apparently in a line of direction farther North.

9. Under this head, is included all the remaining portion of the present formation, namely, from the point where its Western border bends Northerly, in North Stonington, to the most N. Eastern point examined by me. Although within these limits, a number of distinctly marked subordinate ranges are included, yet from the mutual connexion which these have with each other, throughout the greater part of this extent, the whole may be better considered as forming one general group, than under different heads. This general connexion is particularly indicated by a series of Micaceous and Quartz ranges, rarely of any considerable width, but some of them comparatively extensive in the direction of their length, which may be traced, in a Northerly direction, through the greater part of the present section. These will be more particularly described, after having traced the general arrangement of the more granitic rocks of this section.

Before commencing a detailed account of the present sec-

tion, the remarkable range of Lantern Hill (†,) situated on its line of junction with section (7,) may be briefly noticed. This consists of a long narrow ridge, on the confines of North Stonington and Ledyard, extending nearly North and South, along the East side of a line of ponds, at the source of the East branch of the Mystic, and forming a conspicuous object, to a great distance, from its elevation and peculiar aspect. It presents the appearance of a very large dike, perpendicular, both East and West, throughout a considerable part of its extent, particularly towards the North, where it also attains its greatest elevation. It is chiefly composed of an immense bed or vein of a peculiar white Quartz, generally breaking in rather small jointed fragments, and abounding in seams and geodes of crystalline quartz, and not a little resembles a similar bed or vein of Quartz at Dobson's Factory (Vernon,) and others connected with the peculiar granite, on the frontier of the Eastern Primary, in East Haven and Branford, already noticed under section (1) of the present formation. Like those it contains traces of copper, and seams of specular iron. This vein traverses the summit of the ridge, in its N. and S. direction, apparently crossing the strata of the granitic gneiss of the present formation, nearly directly transversely. It is bordered immediately by a peculiar quartzy granitic rock, with a grain distinctly parallel, and closely resembling, in structure, the adjoining granitic gneiss, with which it is apparently continuous. This is usually of a light greenish grey, with more or less of silvery or greenish talc disseminated and in parallel seams, and usually abounds in small detached veins and geodes of crystalline quartz, and often in pyrites. Apparently the Granitic Gneiss, as it approaches the central quartz vein, is converted into this peculiar talcose quartzy rock, in which there usually remains but a small proportion of felspar. The general direction of the Granitic Gneiss is E. N. E., and this continues apparently unchanged to the sides of the vein. Farther South, in the valley of the Mystic, at Indian Pond Factory, and on the West side of the valley, in a line nearly in the

direction of the Quartz vein of Lantern Hill, the granitic gneiss of the present formation, particularly in beds of the fine-grained red felspathic variety (β,) breaks often in small jointed fragments, and is filled with small veins and seams of crystalline quartz, occasionally accompanied with pyrites and green talc; apparently indicating that the cause which produced the quartz vein of Lantern Hill was there operative. This range of Quartz, accompanied with Talc, is situated South of a remarkable Hornblendic-Chloritic formation (F 3 α,) approaching within a short distance of the North point of Lantern Hill, and is perhaps connected with it in its formation.

In tracing the more particular arrangement of the Granitic rocks of the present section, the frontier range (a,) of the fine-grained reddish felspathic rock (β,) may be first noticed. This, as has been already observed, passes by the North point of Lantern Hill, and is thence continued N. Easterly, in a distinct ridge (a 1,) through the N. W. part of North Stonington. This ridge is interrupted, about the middle of its course, and recedes to the East, after which it bears more directly N. East. It consists, like that part of the range accompanying section (7,) chiefly of a fine-grained, reddish felspathic, grey-striped, even Granitic Gneiss, usually breaking in flat jointed fragments. It is bordered along the East base of the ridge, and in the valley adjoining East, by a narrow dark micaceous quartziferous range, to be afterwards noticed. This frontier range is then apparently interrupted to a point North of the Pachaug, on the confines of Griswold and Voluntown. It there forms a distinct band (a 2,) of a uniformly fine-grained, light reddish, very felspathic and prismatic rock, adjoining on the West the N. E. point of the Hornblendic-Chloritic formation (F 3 α—β,) already alluded to, on the border of which occur singular alternations of reddish felspathic rocks, generally coarser grained, with Hornblendic, Epidotic and Quartz rocks, which will be noticed in connexion with the latter formation. The range is again interrupted, on the immediate frontier, for some distance, but reappears again in the same position, on the

West side of the high ridge East of Plainfield, where it forms a band (a 3) of some width, of a fine-grained, red or light reddish grey, very felspathic Gneiss, characterized by its extensive flat ledges. It here also adjoins a range of greenish Chloritic rocks, somewhat resembling those of (F 3 β,) subordinate to the Micaceous formation (F 2,) to be afterwards noticed. North of the Moosup, I have not distinctly observed this fine-grained felspathic rock (β,) on the immediate frontier of the formation, till we reach a point East of the valley of Five Mile river, in the S. E. corner of Thompson. From that point it may be noticed generally along the frontier, to the limit of my observations, but rather in subordinate beds in connexion with coarser granitic rocks of the class (α.) Beds of the compactly fine, uniformly red felspathic variety, very generally occur in this part of the frontier, often containing large nodules or imbedded crystals of magnetic iron.

The line of the preceding range (a) is interrupted on the frontier, at the points above noticed, by a series of apparently isolated ranges (b) of a peculiar porphyritic granitic gneiss (class δ.) The first of these (b 1) extends along the Eastern border of the Hornblendic-Chloritic formation (F 3 α—β,) in the S. E. part of Griswold, in the interval between the first and second points of the preceding range (a ;) the second (b 2,) along the Eastern border of the Micaceous formation (F 2,) near the line of Griswold and Plainfield, between the second and third points of the same range (a ;) and the third (b 3,) throughout the long interval between the third and fourth points of that range, along the Eastern border of the same Micaceous formation (F 2,) in Killingly. Traces of a similar porphyritic rock occur along the Western frontier of the present formation, in the S. E. part of Thompson, in a line West of the preceding range (a.) The structure of this porphyritic rock is, on the whole, similar to that of the more common granitic gneiss of the formation (α,) but with distinct porphyritic points of felspar. The porphyritic felspar of this rock is generally red, but in that part of the more Northern range, in

North Killingly and Thompson, a dark purple, accompanied with more strongly marked seams of black mica. In the two Southern ranges, the felspar is a lighter red, and the mica seams generally a lighter grey. The rock is there accompanied by alternate beds of a thin grey more micaceous gneiss, and this latter rock, as well as the mica seams of the porphyritic gneiss, on the immediate Western border of these two ranges, has a distinctly greenish tint, from the vicinity of the Chloritic formation (F 3 α—β,) on the West. The rock, in this latter position, is also more thinly schistose and even, and with less interrupted seams of mica. These latter have a delicate sub-fibrous structure, and a peculiar soft talcy lustre, indicating still farther the relation of this rock to the adjoining Chloritic range on the West. Distinct seams of greenish talc are sometimes noticed. The porphyritic points of felspar are usually more elongated, often passing into the porphyritic veined structure, with minute flakes of mica, more or less frequently disseminated. The rock, in the more Eastern part of these Southern ranges, is thicker bedded, coarser and darker mica-seamed, often very tortuous in its grain, with larger, more rounded porphyritic points of red felspar, adjoining which are often found patches of quartz and dark mica, indicating strikingly the segregative character of the rock. This larger porphyritic rock alternates with a lighter grey, smaller reddish veined porphyritic and porphyritic veined rock, often abounding in porphyritic veined quartz. In the Northern range, the mica seams of the porphyritic rock are darker; less abundant, in the South part of the range, where the rock approaches more nearly in its character the granitic gneiss (α,) into which it passes on the East, but in the Northern part, particularly on the Western border, more strongly marked, as already noticed, forming a dark ground, in which the porphyritic points are more distinctly obvious.

Proceeding farther into the interior of the formation, a range (c) may be distinguished, traversing the middle of North Stonington, in an E. N. Easterly direction, generally consisting of

a white or sub-reddish white, more or less dark mica seamed granitic gneiss, usually ferruginous and decomposable. The surface of the ledges is often of a very pure white, while the interior is much stained, and marked with dark purple seams, especially on its cleavages. In the S. E. part of the range, more particularly, the rock is often thick bedded, and of a very pure white (†,) and would form a valuable material for building, if less liable to discoloration from its ferruginous character. This variety occurs in large beds, alternating with a more mica seamed sub-granitic gneiss, and also with a thin darker grey, more micaceous gneiss, both also quite decomposable. Beds are also met with of a light grey reddish veined porphyritic gneiss, and in the S. W. part of the range, N. W. of Milltown, a subordinate range (†) occurs of a large red Porphyritic rock, quite similar to that of the frontier ranges (*b.*) The Porphyritic rock of this subordinate range is, however, lighter grey and more granitic than that of the frontier ranges generally, with a finer sub-porphyritic ground, and with a finer dark mica, in less strongly marked seams, and more uniformly distributed, as in the Porphyritic rock of Mount Archer (3.) The larger porphyritic rock occasionally consists chiefly of red porphyritic felspar, resembling a coarse red granite, but distinctly retaining its peculiar parallel porphyritic structure. As in the frontier ranges, it alternates with a small veined porphyritic or porphyritic veined rock, and also with bands of a fine-grained dark grey sub-micaceous rock, with a few small rounded porphyritic points of red felspar, and occasionally with disseminated hornblende. Veins of coarse and fine red granite and crystalline quartz also occur in this subordinate range. The detached porphyritic beds generally occur in the more Western part of the present range (*c,*) N. W. of the white granitic rock (†.) On the Southern border of this range, a remarkable range of dark micaceous Quartziferous rock (Q 1) extends East from Milltown, bordered, particularly towards its E. termination, by a reddish Granitic rock, more distinctly

felspathic in its immediate vicinity, which is continued E. N. E., in a narrow range, at least to the valley of the Ashewaug.

A range (d,) apparently consisting almost entirely of a reddish white thick bedded Granitic Gneiss or parallel Granite (a,) with occasional veins of a coarser red and white granite, extends, from the N. E. part of the preceding (c,) along the E. border of Voluntown. It may be considered as terminated, on the N., by a valley bearing Easterly through the N. E. part of that town. This range is characterized by its extensive low flat ledges, which almost entirely occupy a considerable extent of surface in the S. E. part of the same town. The rock in these ledges is generally very hard and indestructible. This range is bordered on the East, at least towards the North, in Exeter (R. I.,) by a range of light grey, more micaceous seamed and decomposable, reddish veined porphyritic or sub-porphyritic granitic gneiss, and a range of similar reddish porphyritic rock occurs on its N. W. border, in Voluntown, the two apparently curving round, on the South side of the valley, above noticed, so as to meet, and inclose the present range on the North.

The interval between the S. part of this range, and the S. Porphyritic range (b 1,) is occupied by a tract (e,) of very considerable width on the S., but apparently running out, nearly in a point, on the N., characterized by a remarkable alternation of subordinate ranges of reddish Granitic rock (a,) and Dark Micaceous and Quartz rocks. The direction of these ranges is nearly N.—S., generally bearing more or less to the East, conformably to the general direction of the formation. The intervening bands of granitic rock are here usually more red felspathic than in the preceding range (d.) The Micaceous and Quartz ranges will be afterwards more particularly noticed.

East of the second Porphyritic range (b 2,) a comparatively narrow range (f,) composed chiefly of a very light grey, white, more rarely reddish felspathic Granitic Gneiss, extends N. along the ridge E. of the N. part of the Griswold basin,

including Stone Hill, and the singular detached summit, called Mount Misery (Voluntown,) and continued farther North into the S. E. part of Plainfield. This range frequently includes beds of granitic rock very suitable for quarrying. The quarries of Stone Hill are generally known in that section of the State. The rock of these quarries is a coarsish grained white felspathic rock, with a less proportion of grey quartz, and with very little mica; thick bedded, like a granite, but with a parallel structure distinctly observable in its quartz. Beds occur of a similar character, with a light reddish felspar, and also alternate beds of a finer grained, more schistose, white felspathic rock, with strongly marked seams of coarse white mica.

The Granitic Gneiss of the more Northern part of the present formation, may, with a few exceptions, be included under one general head (*g*.) The reddish white or reddish grey, thick bedded Granitic rock (α) here prevails usually to a greater extent than in most parts of the formation, already noticed, with a singular uniformity of character throughout, from Sterling to Sutton. It, however, resembles very strikingly the more granitic varieties of the same, farther S. W., as already noticed in the more general remarks on the rocks of this formation. This part of the formation is traversed, to a considerable distance from North to South, at least from Moosup river, in Plainfield, to the S. E. corner of Thompson, by two important ranges of Quartz rock. That part of the formation, West of the most Western of these ranges, forms a narrow tract, occupied chiefly by the third Porphyritic range (*b* 3,) particularly towards the North. E. of that range, a high ridge may be traced, along the Eastern border of the State, marked by a few transverse interruptions, from the N. line of Voluntown to the Western part of Douglass (Mass.,) whence it is continued round Easterly to the South of Sutton. From the S. E. corner of Thompson, Northwards, it immediately adjoins the Western frontier of the formation. This ridge is nearly in the line of the range (*d*) in the E. part of Voluntown, which it also resembles in the character of its rocks. It is traversed

proportion, subordinate beds of reddish granitic gneiss (a.) A subordinate range, in which the dark mica-seamed gneiss predominates, extends from a point East of Lower Mystic, E. N. E. by the Baptist meeting-house on the Paucatuck Turnpike, apparently to the vicinity of the quarry, West of Paucatuck village. The rock of this range is occasionally sub-hornblendic, and includes alternate beds of dark micaceous gneiss and hornblende, and also beds or veins of coarse granite, usually with white, but sometimes with red felspar, and at other times with points of light red felspar, disseminated in a ground of pure white (albitic) felspar. Another subordinate range, farther S., extending along the base of the hills, N. of Stonington borough, includes frequent beds, sometimes very large, of reddish granitic gneiss, both coarse-grained, darker reddish grey, or reddish white, and fine-grained uniformly red felspathic. In a line farther North, on the West side of the road from Stonington borough to Paucatuck village, is a band of a fine-grained, even, dark green micaceous, or lighter green sub-granitic Gneiss, apparently subchloritic, with disseminated reddish felspar, and with fine longitudinal, slightly oblique stripes or seams of light red felspar; the latter, obviously formed cotemporaneously by segregation. This rock is traversed by longitudinal beds or veins of a coarse or fine bright red felspathic granite, distinctly parallel in its structure. Both the gneiss and granite of this band, particularly the latter, break in small prismatic fragments, occasionally with cross seams of epidote. Farther West, on the West side of the Quiambaug, and in nearly the same line of direction, occurs a band of a similar greenish sub-granitic gneiss, with red felspathic granitic alternations; the latter particularly with sub-porphyritic points of hornblende. The mica in these localities has a peculiar soft talcy lustre, most remarkable in connexion with the deeper red felspar. In the lower grounds, N. of Stonington borough, the dark mica-seamed granitic gneiss predominates, with not unfrequent smaller beds of reddish fine-grained granitic gneiss, and

veins of coarse red granite. Alternate beds of dark micaceous gneiss and hornblende are not unusual.

In a line North of the range (†,) on both sides of the Paucatuck, above the village of that name, occurs a range (‡) of comparatively little width, consisting for the most part, of a thick reddish grey granitic gneiss, generally of a moderately coarse grain, and composed chiefly of a dark red or purplish felspar. This rock, in its structure, not a little resembles that of Millstone Point (in range 6,) presenting little appearance of parallelism in its grain, and like that rock is well adapted for purposes of architecture. It traverses the ridge N. E. of Paucatuck village in Rhode Island, where it has been quarried, to a considerable extent, in the vicinity of the Rail Road, and has been used in the construction of the viaduct, and for other purposes in that vicinity.

Still farther North, a range (††,) of much more considerable width, extends E. N. E. through the contiguous parts of Stonington and North Stonington, and thence through the S. E. part of the latter town into Hopkinton (R. I.) This is characterized by a fine-grained, light grey, thin, even sub-granitic gneiss, with alternations of a darker more micaceous gneiss, and occasional beds of a coarse, nearly white granitic gneiss or parallel granite. All the rocks of this range are extremely decomposable, so much so that entire ledges are rarely seen on the surface. In a line farther North, apparently adjoining the West part of this range, a tract of reddish white Granitic Gneiss, highly decomposable and ferruginous, occurs West of Milltown (North Stonington.) This rock is generally very much stained, red and yellow, with blue and purple seams, as has been already noticed in some of the more Western divisions of the present formation, and not unfrequently decomposes on the surface into a kind of granitic gravel. It is apparently in the line of a range (*c* †,) farther N. E., noticed under the next section (9.) On the Southern border of the range (††,) adjoining the valley of the Paucatuck, in the S. E. corner of North Stonington, is a range of no great width, of a reddish

white, or light reddish grey thick Granitic Gneiss, including a narrow subordinate range or bed, resembling in its character the Quartziferous range (l,) in the South of Ledyard, noticed under the preceding section (7.) This consists of alternate beds of a light or dark grey, coarse and fine, slightly sub-felspathic Quartz rock, and a dark micaceous gneiss, both of which abound more or less in small veins of crystalline quartz and coarse and fine white granite, with patches of hornblende and pyroxene, particularly in the dark micaceous gneiss. At a point towards the Eastern extremity of this range, thin granitic bands occur, more or less abounding in light green pyroxene, and bordered immediately by a coarsely crystalline black hornblende. Larger beds or veins of white Granite also occur, in connexion with this range; sometimes with a fine distinctly parallel felspathic ground, in which are included large veined porphyritic points of white felspar. A similar Micaceous Quartziferous range occurs not far North of Hopkinton village, apparently in a line of direction farther North.

9. Under this head, is included all the remaining portion of the present formation, namely, from the point where its Western border bends Northerly, in North Stonington, to the most N. Eastern point examined by me. Although within these limits, a number of distinctly marked subordinate ranges are included, yet from the mutual connexion which these have with each other, throughout the greater part of this extent, the whole may be better considered as forming one general group, than under different heads. This general connexion is particularly indicated by a series of Micaceous and Quartz ranges, rarely of any considerable width, but some of them comparatively extensive in the direction of their length, which may be traced, in a Northerly direction, through the greater part of the present section. These will be more particularly described, after having traced the general arrangement of the more granitic rocks of this section.

Before commencing a detailed account of the present sec-

tion, the remarkable range of Lantern Hill (†,) situated on its line of junction with section (7,) may be briefly noticed. This consists of a long narrow ridge, on the confines of North Stonington and Ledyard, extending nearly North and South, along the East side of a line of ponds, at the source of the East branch of the Mystic, and forming a conspicuous object, to a great distance, from its elevation and peculiar aspect. It presents the appearance of a very large dike, perpendicular, both East and West, throughout a considerable part of its extent, particularly towards the North, where it also attains its greatest elevation. It is chiefly composed of an immense bed or vein of a peculiar white Quartz, generally breaking in rather small jointed fragments, and abounding in seams and geodes of crystalline quartz, and not a little resembles a similar bed or vein of Quartz at Dobson's Factory (Vernon,) and others connected with the peculiar granite, on the frontier of the Eastern Primary, in East Haven and Branford, already noticed under section (1) of the present formation. Like those it contains traces of copper, and seams of specular iron. This vein traverses the summit of the ridge, in its N. and S. direction, apparently crossing the strata of the granitic gneiss of the present formation, nearly directly transversely. It is bordered immediately by a peculiar quartzy granitic rock, with a grain distinctly parallel, and closely resembling, in structure, the adjoining granitic gneiss, with which it is apparently continuous. This is usually of a light greenish grey, with more or less of silvery or greenish talc disseminated and in parallel seams, and usually abounds in small detached veins and geodes of crystalline quartz, and often in pyrites. Apparently the Granitic Gneiss, as it approaches the central quartz vein, is converted into this peculiar talcose quartzy rock, in which there usually remains but a small proportion of felspar. The general direction of the Granitic Gneiss is E. N. E., and this continues apparently unchanged to the sides of the vein. Farther South, in the valley of the Mystic, at Indian Pond Factory, and on the West side of the valley, in a line nearly in the

direction of the Quartz vein of Lantern Hill, the granitic gneiss of the present formation, particularly in beds of the fine-grained red felspathic variety (β,) breaks often in small jointed fragments, and is filled with small veins and seams of crystalline quartz, occasionally accompanied with pyrites and green talc; apparently indicating that the cause which produced the quartz vein of Lantern Hill was there operative. This range of Quartz, accompanied with Talc, is situated South of a remarkable Hornblendic-Chloritic formation (F 3 α,) approaching within a short distance of the North point of Lantern Hill, and is perhaps connected with it in its formation.

In tracing the more particular arrangement of the Granitic rocks of the present section, the frontier range (a,) of the fine-grained reddish felspathic rock (β,) may be first noticed. This, as has been already observed, passes by the North point of Lantern Hill, and is thence continued N. Easterly, in a distinct ridge (a 1,) through the N. W. part of North Stonington. This ridge is interrupted, about the middle of its course, and recedes to the East, after which it bears more directly N. East. It consists, like that part of the range accompanying section (7,) chiefly of a fine-grained, reddish felspathic, grey-striped, even Granitic Gneiss, usually breaking in flat jointed fragments. It is bordered along the East base of the ridge, and in the valley adjoining East, by a narrow dark micaceous quartziferous range, to be afterwards noticed. This frontier range is then apparently interrupted to a point North of the Pachaug, on the confines of Griswold and Voluntown. It there forms a distinct band (a 2,) of a uniformly fine-grained, light reddish, very felspathic and prismatic rock, adjoining on the West the N. E. point of the Hornblendic-Chloritic formation (F 3 α—β,) already alluded to, on the border of which occur singular alternations of reddish felspathic rocks, generally coarser grained, with Hornblendic, Epidotic and Quartz rocks, which will be noticed in connexion with the latter formation. The range is again interrupted, on the immediate frontier, for some distance, but reappears again in the same position, on the

West side of the high ridge East of Plainfield, where it forms a band (a 3) of some width, of a fine-grained, red or light reddish grey, very felspathic Gneiss, characterized by its extensive flat ledges. It here also adjoins a range of greenish Chloritic rocks, somewhat resembling those of (F 3 β,) subordinate to the Micaceous formation (F 2,) to be afterwards noticed. North of the Moosup, I have not distinctly observed this fine-grained felspathic rock (β,) on the immediate frontier of the formation, till we reach a point East of the valley of Five Mile river, in the S. E. corner of Thompson. From that point it may be noticed generally along the frontier, to the limit of my observations, but rather in subordinate beds in connexion with coarser granitic rocks of the class (α.) Beds of the compactly fine, uniformly red felspathic variety, very generally occur in this part of the frontier, often containing large nodules or imbedded crystals of magnetic iron.

The line of the preceding range (a) is interrupted on the frontier, at the points above noticed, by a series of apparently isolated ranges (b) of a peculiar porphyritic granitic gneiss (class δ.) The first of these (b 1) extends along the Eastern border of the Hornblendic-Chloritic formation (F 3 α—β,) in the S. E. part of Griswold, in the interval between the first and second points of the preceding range (a ;) the second (b 2,) along the Eastern border of the Micaceous formation (F 2,) near the line of Griswold and Plainfield, between the second and third points of the same range (a ;) and the third (b 3,) throughout the long interval between the third and fourth points of that range, along the Eastern border of the same Micaceous formation (F 2,) in Killingly. Traces of a similar porphyritic rock occur along the Western frontier of the present formation, in the S. E. part of Thompson, in a line West of the preceding range (a.) The structure of this porphyritic rock is, on the whole, similar to that of the more common granitic gneiss of the formation (α,) but with distinct porphyritic points of felspar. The porphyritic felspar of this rock is generally red, but in that part of the more Northern range, in

North Killingly and Thompson, a dark purple, accompanied with more strongly marked seams of black mica. In the two Southern ranges, the felspar is a lighter red, and the mica seams generally a lighter grey. The rock is there accompanied by alternate beds of a thin grey more micaceous gneiss, and this latter rock, as well as the mica seams of the porphyritic gneiss, on the immediate Western border of these two ranges, has a distinctly greenish tint, from the vicinity of the Chloritic formation (F 3 α—β_1) on the West. The rock, in this latter position, is also more thinly schistose and even, and with less interrupted seams of mica. These latter have a delicate sub-fibrous structure, and a peculiar soft talcy lustre, indicating still farther the relation of this rock to the adjoining Chloritic range on the West. Distinct seams of greenish talc are sometimes noticed. The porphyritic points of felspar are usually more elongated, often passing into the porphyritic veined structure, with minute flakes of mica, more or less frequently disseminated. The rock, in the more Eastern part of these Southern ranges, is thicker bedded, coarser and darker mica-seamed, often very tortuous in its grain, with larger, more rounded porphyritic points of red felspar, adjoining which are often found patches of quartz and dark mica, indicating strikingly the segregative character of the rock. This larger porphyritic rock alternates with a lighter grey, smaller reddish veined porphyritic and porphyritic veined rock, often abounding in porphyritic veined quartz. In the Northern range, the mica seams of the porphyritic rock are darker; less abundant, in the South part of the range, where the rock approaches more nearly in its character the granitic gneiss (α_1) into which it passes on the East, but in the Northern part, particularly on the Western border, more strongly marked, as already noticed, forming a dark ground, in which the porphyritic points are more distinctly obvious.

Proceeding farther into the interior of the formation, a range (c) may be distinguished, traversing the middle of North Stonington, in an E. N. Easterly direction, generally consisting of

a white or sub-reddish white, more or less dark mica seamed granitic gneiss, usually ferruginous and decomposable. The surface of the ledges is often of a very pure white, while the interior is much stained, and marked with dark purple seams, especially on its cleavages. In the S. E. part of the range, more particularly, the rock is often thick bedded, and of a very pure white (†,) and would form a valuable material for building, if less liable to discoloration from its ferruginous character. This variety occurs in large beds, alternating with a more mica seamed sub-granitic gneiss, and also with a thin darker grey, more micaceous gneiss, both also quite decomposable. Beds are also met with of a light grey reddish veined porphyritic gneiss, and in the S. W. part of the range, N. W. of Milltown, a subordinate range (‡) occurs of a large red Porphyritic rock, quite similar to that of the frontier ranges (*b*.) The Porphyritic rock of this subordinate range is, however, lighter grey and more granitic than that of the frontier ranges generally, with a finer sub-porphyritic ground, and with a finer dark mica, in less strongly marked seams, and more uniformly distributed, as in the Porphyritic rock of Mount Archer (3.) The larger porphyritic rock occasionally consists chiefly of red porphyritic felspar, resembling a coarse red granite, but distinctly retaining its peculiar parallel porphyritic structure. As in the frontier ranges, it alternates with a small veined porphyritic or porphyritic veined rock, and also with bands of a fine-grained dark grey sub-micaceous rock, with a few small rounded porphyritic points of red felspar, and occasionally with disseminated hornblende. Veins of coarse and fine red granite and crystalline quartz also occur in this subordinate range. The detached porphyritic beds generally occur in the more Western part of the present range (*c*,) N. W. of the white granitic rock (†.) On the Southern border of this range, a remarkable range of dark micaceous Quartziferous rock (Q 1) extends East from Milltown, bordered, particularly towards its E. termination, by a reddish Granitic rock, more distinctly

felspathic in its immediate vicinity, which is continued E. N. E., in a narrow range, at least to the valley of the Ashewaug.

A range (*d*,) apparently consisting almost entirely of a reddish white thick bedded Granitic Gneiss or parallel Granite (*a*,) with occasional veins of a coarser red and white granite, extends, from the N. E. part of the preceding (*c*,) along the E. border of Voluntown. It may be considered as terminated, on the N., by a valley bearing Easterly through the N. E. part of that town. This range is characterized by its extensive low flat ledges, which almost entirely occupy a considerable extent of surface in the S. E. part of the same town. The rock in these ledges is generally very hard and indestructible. This range is bordered on the East, at least towards the North, in Exeter (R. I.,) by a range of light grey, more micaceous seamed and decomposable, reddish veined porphyritic or sub-porphyritic granitic gneiss, and a range of similar reddish porphyritic rock occurs on its N. W. border, in Voluntown, the two apparently curving round, on the South side of the valley, above noticed, so as to meet, and inclose the present range on the North.

The interval between the S. part of this range, and the S. Porphyritic range (*b* 1,) is occupied by a tract (*e*,) of very considerable width on the S., but apparently running out, nearly in a point, on the N., characterized by a remarkable alternation of subordinate ranges of reddish Granitic rock (*a*,) and Dark Micaceous and Quartz rocks. The direction of these ranges is nearly N.—S., generally bearing more or less to the East, conformably to the general direction of the formation. The intervening bands of granitic rock are here usually more red felspathic than in the preceding range (*d*.) The Micaceous and Quartz ranges will be afterwards more particularly noticed.

East of the second Porphyritic range (*b* 2,) a comparatively narrow range (*f*,) composed chiefly of a very light grey, white, more rarely reddish felspathic Granitic Gneiss, extends N. along the ridge E. of the N. part of the Griswold basin,

including Stone Hill, and the singular detached summit, called Mount Misery (Voluntown,) and continued farther North into the S. E. part of Plainfield. This range frequently includes beds of granitic rock very suitable for quarrying. The quarries of Stone Hill are generally known in that section of the State. The rock of these quarries is a coarsish grained white felspathic rock, with a less proportion of grey quartz, and with very little mica; thick bedded, like a granite, but with a parallel structure distinctly observable in its quartz. Beds occur of a similar character, with a light reddish felspar, and also alternate beds of a finer grained, more schistose, white felspathic rock, with strongly marked seams of coarse white mica.

The Granitic Gneiss of the more Northern part of the present formation, may, with a few exceptions, be included under one general head (*g*.) The reddish white or reddish grey, thick bedded Granitic rock (α) here prevails usually to a greater extent than in most parts of the formation, already noticed, with a singular uniformity of character throughout, from Sterling to Sutton. It, however, resembles very strikingly the more granitic varieties of the same, farther S. W., as already noticed in the more general remarks on the rocks of this formation. This part of the formation is traversed, to a considerable distance from North to South, at least from Moosup river, in Plainfield, to the S. E. corner of Thompson, by two important ranges of Quartz rock. That part of the formation, West of the most Western of these ranges, forms a narrow tract, occupied chiefly by the third Porphyritic range (*b* 3,) particularly towards the North. E. of that range, a high ridge may be traced, along the Eastern border of the State, marked by a few transverse interruptions, from the N. line of Voluntown to the Western part of Douglass (Mass.,) whence it is continued round Easterly to the South of Sutton. From the S. E. corner of Thompson, Northwards, it immediately adjoins the Western frontier of the formation. This ridge is nearly in the line of the range (*d*) in the E. part of Voluntown, which it also resembles in the character of its rocks. It is traversed

in Killingly by the Eastern Quartz range. With this exception, it consists mainly of the granitic rock (a_1) generally thick bedded and rather coarse-grained, with but few sub-granitic and micaceous alternations. The fine-grained felspathic rock on its Western border, where it adjoins the frontier of the formation, has been already noticed. A similar fine-grained felspathic gneiss also occurs adjoining the Quartz ranges of Killingly, and on the E. side of the ridge in Douglass (Mass.) Along its W. border, E. of Thompson, beds occur of a coarse or fine white crystalline Quartz rock, with parallel seams of white mica and greenish talc, accompanied with a coarse reddish white granitic gneiss, with seams of coarse white mica and white quartz. Veins and nests of crystalline quartz are not unfrequent in the more granitic rocks of this part of the formation.

In a line E. of the high ridge last noticed, a range (h) extends along the Eastern border of Sterling, and through the adjoining part of Rhode Island (West Greenwich and Coventry,) and bearing more Easterly may apparently be traced along a line passing W. of Foster, and by Pascoag village (Burrillville.) This range consists chiefly of a coarse dark mica-seamed, large Porphyritic gneiss, generally with bluish or purple felspar, and a dark grey sub-porphyritic veined, or more even striped gneiss, with alternate bands of dark micaceous gneiss and Hornblende. The Porphyritic rock of this range is generally coarser grained than that of the ranges, already noticed in the present division (g_1,) with a more distinct porphyritic veined structure, and with stronger seams of shining flaky black mica. A thicker bedded variety often occurs, particularly in the Southern part of the range, chiefly composed of oblong porphyritic points of bluish or purple felspar, distinctly compound, with patches of black mica and bluish quartz interposed; the whole resembling a coarse granite. The dark mica-seamed, sub-porphyritic veined gneiss is occasionally subhornblendic, passing into a similar sub-porphyritic veined dark Hornblende. The rocks of this range are generally very decomposable, particularly the coarser Porphyritic variety. A

tract of this, in the W. part of West Greenwich, decomposes, to a considerable depth, into a coarse granitic gravel. This range is of greater width on the S., but towards the N. forms apparently a narrow band connected with the reddish granitic gneiss of class (*a*.) It is perhaps connected on the S. with the Porphyritic rock on the East border of the range (*d*,) in Exeter (R. I.)

It remains now to point out more particularly the Micaceous and Quartz ranges, traversing the present section (9.) The Micaceous ranges generally consist, as has been stated in the introductory remarks on the different classes of rocks in the present formation, of alternate beds of darker and lighter grey, more or less micaceous, quartz and granite veined gneiss, and grey micaceous quartz, (the last occasionally subfelspathic,) not unfrequently accompanied with beds of hornblende, and larger veins or beds of coarse white granite. Patches of hornblende and epidote are often disseminated in the micaceous rocks of these ranges. A remarkable range (Q 1) of this kind, already referred to, extends nearly East from Milltown (North Stonington) about half way to the East line of the State. This range is about E. S. E. from the narrow band of similar character, adjoining, on the East, the frontier range of fine-grained felspathic rock, E. N. E. of Lantern Hill, and is also apparently nearly in the same East and West line, as the Micaceous range (7†) at Stoddard's Ferry (Ledyard,) which it very nearly resembles in the character of its rocks. It consists of a low rocky ridge, broken by several transverse valleys, offering a striking contrast with the smooth swells of the more granitic rocks adjoining. It includes, in one of its elevations, near its middle point, beds of a greenish pyroxenic limestone, already referred to. It also contains beds or veins of the very quartzy granite, already noticed under the quartziferous range (7 †.) Beds of dark green hornblende are frequent at its Western point, at Milltown; partly thick bedded and sub-porphyritic (Sienitic.) This range, particularly at its Eastern extremity, as already noticed under (*c*,) is immediately bordered by a band of a reddish very felspathic rock

(class *a*.) This connexion of the Micaceous and Quartz ranges of the present formation with a more purely felspathic, usually reddish variety of granitic rock, has already been referred to, and will be observed still more strikingly in the Quartz ranges of Killingly (Q 3—4.) The quartziferous ranges, connected with the range (8 11,) in the S. E. corner of North Stonington, and in Hopkinton (R. I.,) may perhaps be connected with the present, forming an interrupted series, continued in an undulating course, Easterly.

The range accompanying the first point (*a* 1) of the frontier felspathic range, on its E. border, has been already noticed in that connexion. This is apparently the Southern commencement of a more extended range (Q 2,) continued N. through the range or tract (*e*,) in Voluntown, and thence along a valley, between the frontier ridge of the present formation, East of Plainfield, occupied by (*a* 3—*f*,) and the high ridge of Sterling (*g*,) to the S. point of the Western Quartz range of Killingly (Q 3.) The range accompanying (*a* 1,) shifts to the East, in the manner already noticed. A similar recession to the East is required to bring this range into connexion with the tract (*e*,) extending along the confines of Voluntown and North Stonington, both E. and W. of Pendleton Hill. This tract (*e*) may be regarded as a range composed of a series of alternate bands of dark micaceous quartziferous gneiss and reddish granitic gneiss, the two classes of rocks being, in some parts, arranged in smaller alternate beds, and in others, in larger more detached subordinate ranges. In the former case, the granitic gneiss is usually finer grained, and often light grey striped, resembling more the rock of the frontier range (*a* 1,) with more frequent veins of coarse red granite. Two larger parallel bands of the micaceous quartziferous rock, with hornblende, occur on the E. side of a lower ridge W. of Pendleton Hill, and on the summit and Eastern declivity of a broad tabular ridge, N. E. of the latter point, are observed two parallel ranges of Quartz rock, corresponding, in a singular manner, to the two Quartz ranges in Killingly. On the summit of the pla-

teau, is a range of grey Quartz rock, very closely resembling that of the Western range, in Killingly, and bordered immediately, both E. and W., by ranges of dark micaceous quartziferous gneiss. The Quartz rock of this range is within of a reddish grey, but nearly white on its weathered surface. Its grain is usually compactly fine, and it breaks in regular flat jointed fragments. Farther East, is a wide band of a rather coarse reddish white Granitic rock (a,) resembling that of the range (d,) still farther East. E. of this band, on the W. side of the valley of the Ashewaug, bounding the plateau on the E., is a second range of Quartz rock, almost precisely resembling that of the Eastern range in Killingly, being, like that, characterized by a minute spicular light green hornblende, more or less freely disseminated. East of the Ashewaug, is a broad band of dark micaceous quartz and granite veined gneiss, with hornblende, adjoining, on its Eastern border, the granitic rock (a) of the range (d.)

In the N. W. part of Voluntown, the range or tract (e) traverses the valley of the Pachaug and its Western branch, there becoming quite narrow. I observed there only the dark micaceous quartziferous rock, which presented there frequent nodules of hornblende and epidote. A range of the same Micaceous rock also occurs in the valley between (f) and (g,) already noticed, between Plainfield and Sterling. Continuing in apparently the same line farther north, we arrive at the S. point of the Western Quartz range of Killingly (Q 3.) This latter range may be traced from a point on the Moosup river, not far E. of the upper Factories, in Plainfield, and apparently in the line of the valley, last noticed, in a direction nearly N. (N.N.E.) to the valley of Five Mile river, E. of North Killingly. In the vicinity of Moosup river, it presents only a series of small beds of Quartz rock, alternating with a fine-grained Granitic Gneiss; but not far N. a ridge commences, on the N. side of Moosup Pond, chiefly occupied by a wide range of Quartz rock, which is continued, with occasional interruptions, to the point above mentioned. A valley, nearly in the line of that farther S. con-

nected with (*e*,) ranges along its E. side throughout the greater part of its extent. The central part of this range consists chiefly of a compactly fine sub-micaceous Quartz rock; reddish grey within, but nearly white on its weathered surface; generally very even and fissile, with slight seams of fine grey mica; occasionally thick bedded, when it is more disposed to cleave in jointed fragments, but more usually of moderate thickness, or quite thin, and then often breaking in very large even slabs, forming an excellent material for flagging. This rock has been quarried, to some extent, in Killingly, N. of the Ashford and Providence (Middle Killingly) Turnpike. It alternates with, and is bordered, on the sides of the range, by a darker grey thinner more micaceous Quartz rock, passing into a dark grey Mica Slate. Along the Eastern border of this range, extends a subordinate range of a coarse white crystalline Quartz rock, seamed with white and sometimes greenish (talcy) mica, with occasional points of veined porphyritic white and red felspar, and more frequent seams and nodules of epidote. This sometimes alternates with a darker more micaceous quartzy rock, with hornblende occasionally disseminated. Garnets sometimes occur in the rocks of this subordinate range. It is sometimes separated from the main Quartz range by a band of a reddish granitic rock, usually much veined and seamed with quartz. It may be traced as far S. as Moosup river, but is apparently of little width, till N. of the South Killingly Turnpike. In the more Southern part of its course, it rather forms subordinate beds in the more felspathic Granitic rock, immediately adjoining the Quartz. North of the Middle Killingly Turnpike, it forms a wide range, traversing the valley West of Chesnut Hill. It is apparently continued in the white mica seamed Quartz, noticed on the W. border of the present formation, E. of Thompson. The present Quartz range apparently terminates in a narrow band of a thin grey micaceous Quartz rock, traversing the plain on the E. side of Five Mile river, near the line of Killingly and Thompson, and quite on the W. border of the formation. This range is bordered, at least in a part of

its course, particularly in its S. part, in Plainfield, by a fine-grained, even, reddish felspathic gneiss, marked by very fine light grey sub-micaceous seams; sometimes thin and fissile, like the Quartz rock; at other times, as in the vicinity of Moosup river, thicker, and breaking in regular blocks and fragments, often with dark purple stained cleavage seams. This rock is quarried in the latter situation, by means of its cleavage seams, and has been used in the construction of the factories in that vicinity. The thicker bedded Quartz rock, in the Northern part of the present range, in Killingly, is also quarried by means of its cleavage seams, and is used in the same manner in building. In the line of this range, S. of the Middle Killingly Turnpike, a bed of opaque white, rather thinly fissile Quartz rock was exposed by excavation, which had suffered a partial decomposition; the surface of its layers being covered with a fine white powder, probably derived from the decomposition of its mica seams. This is generally known as the Porcelain rock, in that vicinity.

The Eastern Quartz range of Killingly (Q 4) extends along the W. side of the summit of the high ridge in (*g*,) ranging N. from Sterling along the E. border of the State, at least from the N. E. corner of Plainfield, in a line not far E. of South Killingly meeting-house, to the falls at Eastfield, whence it is continued N. along the ridge of Chesnut Hill to the North Killingly Turnpike. It there apparently bends E. into Rhode Island, at a point nearly E. of the Easterly bend of the Western border of the present formation, adjoining the valley of Five Mile river, in North Killingly. This range generally consists of a rather thick light grey Quartz rock, of similar grain with that of the preceding range, and usually filled with a minutely spicular light green Hornblende. It is rarely as perfectly even, as that of the preceding range, and is often very regularly grooved or fluted, in a longitudinal direction, on the surface of its layers. It is occasionally very decomposable, as at the North Killingly Turnpike, from the presence of its spicular Hornblende, or of minutely disseminated pyrites. This

rock is accompanied, as in the former range, with alternations of a thinner more micaceous Quartz rock, or quartzose Mica Slate, and sometimes with thin interposed layers of red felspar. This range is bordered, particularly on its E. side, from Eastfield Northward, by a band, there of considerable width, of a fine-grained reddish felspathic gneiss, generally very ferruginous and decomposable; partly grey striped, like that adjoining the preceding range, and partly thicker bedded, and of a uniform light reddish grey, frequently with strong red or yellow ferruginous stains. This rock, particularly as it approaches the Quartz range on the West, presents alternate stripes or bands of a darker grey more micaceous and quartzy, thinner fissile variety, often exhibiting in its layers, the peculiar undulations or flutings, observed in the adjoining Quartz range. These are marked by stronger mica seams than the general surface of the layers, and in the more felspathic rocks of this range, similar detached parallel seams of dark mica, usually quite small, may also be noticed. At a point S. S. E. of the Southern point of the present range, as above indicated, traces of its apparent continuation may be observed in the S. end of a diluvial-covered ridge, just W. of the Quantock Factory, in Sterling (Q?) The surface is there, in part, thickly covered, as if in place, by regular jointed fragments of a light grey Quartz rock, rather resembling that of the Western range, but with the light green spicular hornblende of the Eastern range occasionally disseminated.

The Micaceous and Quartziferous ranges, to which I have given so much space in the preceding detail, occupy comparatively a small space in the whole formation, which is strongly marked by the predominance of felspar in its rocks, justly entitling it to the character of a Granitic formation. Still, with few exceptions, the parallel or stratified structure of its rocks is very obvious.

B.

Under this head, is included a group of formations or ranges, occupying the greater part of the Eastern Primary, W. of Con-

necticut river, and N. of the limits of the preceding formation (A,) and also two small tracts on the E. side of that river, one between Portland and Middle Haddam, and another S. of the latter place. I shall also notice, in this connexion, from its peculiar relations to one or two of the members of the present group, a range (*) already referred to under the preceding formation (A 3 3.) The different members of this division are apparently arranged in a manner, which I have not distinctly observed in any other part of either the Eastern or Western Primary, but which would here seem to be sufficiently obvious. This arrangement apparently consists of a central nucleus of Granitic Gneiss, surrounded by narrow concentric ranges of various character. This concentric arrangement is most clearly indicated by a range immediately adjoining the granitic nucleus, characterized by the almost constant presence of anthophyllite, which I have distinctly traced through nearly the entire circle enclosing the granitic centre. The particulars of this arrangement will be more fully exhibited, in the detailed account of the different parts composing the present group, beginning with the most central, and proceeding successively to the exterior formations.

1. *The Central Granitic Formation* (Gneiss.)

This extends from near the South line of Middletown, on the West bank of Connecticut river, on the North, to a point nearly half way between Killingworth and Clinton, on the South; and on the line of the Essex Turnpike, from near North Madison meeting-house on the West, at least to Winthrop village (Saybrook,) on the East. It presents, in the whole, an oval outline, rather wider towards the South. The Turnpike from Clinton to Higganum village (Haddam,) traverses it from the latter place to its Southern limit, passing rather East of its longest diameter, namely, that from North to South. At its Northern extremity, this formation crosses the Connnecticut, and occupies, to a small extent, the Western point of Haddam Neck, opposite Higganum.

The predominant rock throughout this extent, is a light or dark grey Granitic or sub-granitic Gneiss, with white felspar, and more or less distinctly marked seams of black mica. These last have a character not entirely peculiar to this formation, but perhaps more strikingly exhibited in it than in any other. The scales of mica are so arranged in these seams, as to present between them small round points of white felspar, giving to the surface of the layers a peculiar mottled appearance. This character is observable, but in a less remarkable degree, in the granitic gneiss of the preceding formation, and in that of some other formations in the Eastern Primary, particularly in that of a Granitic range (C 4,) extending along the East side of the Bolton range of Mica Slate (C 3.) Indeed, it may be regarded as a general distinctive character of the Eastern Primary, as contrasted with the Western, and may be observed even in the structure of its micaceous and hornblendic rocks, particularly in the micaceous gneiss, accompanying (A,) and in the peculiar micaceous gneiss of (E 1.)

The granitic rock of this formation varies, from the variable proportion of its mica seams, from a nearly pure white, thick bedded felspathic gneiss, to a dark mica-seamed more fissile gneiss, passing into a thin sub-micaceous gneiss. These different varieties sometimes occur together in alternate beds, and sometimes characterize different subordinate ranges. Occasionally beds, and even small subordinate ranges occur in this formation, of a granitic gneiss with red felspar. This generally presents a finer grained, white felspathic ground, with the red felspar distributed in the form of small coarser parallel granite veins, or in veined porphyritic nodules; but in some instances, beds of a rather fine-grained uniform red felspathic rock occur, similar to the corresponding variety of the preceding formation. This latter, particularly, is characterized by disseminated magnetic iron. The reddish veined variety more generally occurs on the borders of the formation, particularly on its Western border, where it forms quite a distinct band adjoining the Anthophyllitic formation (2.) A range of a sim-

ilar kind also occurs near the middle of the formation, in the line of the Higganum Turnpike in Killingworth, characterized by a very light grey ground, weathering nearly white, with small tortuous veins and larger beds of red felspar granite. West of this, adjoining the Hammonasset, and extending N. through the N. W. part of Killingworth, is another range, characterized by a darker grey, more strongly mica seamed variety, with disseminated hornblende, resembling nearly the peculiar rock of the Sub-granitic formation (4.) East of Killingworth, towards the Eastern border of the formation, is a range of a lighter grey white felspathic variety, with frequent beds or veins of coarse white granite, and with garnets disseminated. The latter indeed occur not unfrequently in the granitic gneiss throughout the whole formation. On the Southern border of this formation, S. E. of Killingworth, extends a range of a coarse, usually light grey granitic gneiss, very contorted in its structure, abounding in small irregular veins and nests of coarse and fine white felspar granite, and with grains and nodules of magnetic iron frequently disseminated. This rock sometimes resembles a coarse white granite, but with occasional parallel seams of dark mica, and with interrupted bands or isolated patches of dark micaceous gneiss and hornblende. The granitic gneiss, at the Northern termination of the formation, in the vicinity of Higganum, is generally very light grey, and white felspathic, with occasional thick beds of a still more felspathic variety, as on the E. side of the Trap Dike, at Cedar Hill, where it breaks in large regular jointed fragments.

The more granitic rock of the formation not unfrequently alternates with a darker grey thin sub-micaceous gneiss, and occasionally with a dark thinly schistose Hornblende; the latter sometimes forming subordinate ranges, accompanied with beds of coarse white granite. Beds of a dark-green, thick bedded, porphyritic veined Hornblende rock, with pyroxene, garnets and iron pyrites disseminated, occur, apparently in a narrow range, along the East border of the forma-

tion in the South of Haddam and the North West part of Saybrook. The garnets in this rock are light red, and usually very small, and are grouped in small interrupted veins and detached nodules, but rarely singly disseminated. Small veins of a rather coarse bluish white felspathic granite occur in this rock, with large crystals of hornblende disseminated. This thicker bedded variety sometimes alternates with a thinner schistose sub-porphyritic black Hornblende, usually very decomposable. The rock of this formation, particularly the more micaceous varieties, is frequently very decomposable and ferruginous. This apparently characterizes a range extending along the ridge S. of Higganum, from the S. W. corner of Haddam, to a point S. E. of that village. The more granitic varieties are often well suited for quarrying, particularly the light grey variety, adjoining the Connecticut, and the darker sub-hornblendic variety, near the Hammonasset.

The direction of the strata apparently conforms, in general, to the outline of the formation. This is more especially remarkable in the ridges at its Northern extremity, which appear to curve round concentrically from N. E. on the West, to S. E. on the East; the valley of the East branch of Higganum river traversing nearly the middle of the arc. The exterior ridge of the formation here apparently crosses the Connecticut, from Maromus (Middletown) to Haddam Neck, and again to the West bank of that river, between Higganum and Haddam meeting-house, while the next most considerable ridge bends round within the preceding, S. of Higganum village. The S. Eastern part of the formation forms an extensive plateau, traversed by the Clinton and Higganum Turnpike. Throughout the greater part of its extent, the rock lies nearly horizontally, with an undulating surface to its strata, presenting no distinct direction or dip. This is particularly observable in the white granite veined range on its Southern border. In the ridges, curving round from West to East, in the Northern part of the formation, the dip is generally moderate Northerly, from the centre outward.

The S. Eastern Trap Dike, connected with the Eastern Primary, enters this formation in the N. W. part of Killingworth, where it ranges Easterly. It then bears N. through the Western part of Haddam, to the West bank of the Connecticut, at Higganum Ferry, and reappearing in connexion with the granitic rock of this formation, on the opposite side of the river, soon enters the adjoining Anthophyllitic formation (2.)

2. *The Anthophyllitic Formation* (Gneiss.)

This forms a narrow range, apparently encircling the preceding formation, at least on every side except the South, and even there it may be satisfactorily traced for a considerable part of the distance. The above name has been given it from the abundance of Anthophyllite found in certain varieties of its rocks throughout nearly its whole extent, so far as I have examined it. This formation first appears distinctly on the West, not far North of Guilford borough, where it forms a comparatively wide range on both sides of Guilford river. It extends, however, apparently farther W., along the ridge of Moose Hill, to a point at least three miles from Guilford, in the Northern part of the range (††,) noticed under the first section (1) of the Granitic formation (A.) The rock in that direction strikingly resembles that of the present formation, although I did not there observe the presence of anthophyllite. From the point above mentioned, North of Guilford borough, this formation extends N. N. Easterly, in an apparently uninterrupted range, along a line West of the North meeting-house in Madison, through Black Rock, in the N. part of that town, and through the N. W. corner of Killingworth, the S. E. corner of Durham, and the N. W. corner of Haddam, to Maromus, in the S. E. corner of Middletown. It then bears around East and S. East, in the same uninterrupted range, crossing the Connecticut to Haddam Neck, and again to its West bank at Haddam meeting-house, and is farther continued in a more Southerly direction, through Haddam, and by the West side of Cedar Pond (Chester,) at least to the

Essex Turnpike, about a mile East of Winthrop village (Saybrook.) In all the sections which I have made in this part of the country, I have uniformly found the formation strongly marked, within the limits here represented. The mode in which I have prosecuted the survey, by sections from West to East, has not offered me the same opportunity for determining its continuity, along the Southern border of the preceding formation (1;) still I have observed satisfactory traces of it, in a number of points, North of Madison, Clinton and Westbrook. In these, either the Anthophyllitic rock itself was distinctly observed, or other rocks occurred, closely resembling those which alternate with the latter, within the undoubted limits of the formation. The circular arrangement of this formation, around the preceding, as a central nucleus, thus appears to be capable of almost complete demonstration. Other instances, of a less remarkable kind, occur both in the Eastern and Western Primary; particularly in the arrangement of the Granitic basins connected with the formation (G,) in the latter. The present formation is, perhaps, on the whole, more strongly marked by the peculiar character of its rocks, and by its accompanying minerals, than any other, in either the Eastern or Western Primary; thus rendering the determination of its extent and arrangement more easy and obvious.

This formation consists of a group of Granitic and Micaceous rocks, distinguished as well by their very peculiar character, as by the presence of Anthophyllite in some of its members. The more granitic rocks of the formation are partly extremely fine-grained and even, either light grey, marked by very delicate parallel seams, or nearly uniformly white felspathic, both occasionally with parallel veins and patches, more coarsely granitic; and partly coarser grained and less even, with parallel seams or flakes of a dark grey, sometimes greenish mica. The Micaceous rocks of the formation are also partly fine-grained, dark grey, and uniform in their structure, and partly coarser grained, often very tortuous, with seams of a

coarse flaky, dark greenish mica. Both varieties are not unfrequently sub-hornblendic, particularly the finer grained.

The Anthophyllite is found in certain rocks, both of the granitic and micaceous classes, and corresponds in its character with that of the rock in which it is included. Two varieties of this mineral may be noticed; one of a dark hair-brown, varying to dark green or black, and coarse-grained, forming large parallel seams or patches, with the peculiar flower-like character of the mineral in great perfection; the other of a light straw colour, and more or less minutely spicular, occurring in seams, or disseminated (sometimes in great abundance,) and often very nearly resembling the spicular hornblende in the Eastern Quartz range in Killingly. The coarser variety accompanies some of both the granitic and micaceous rocks of coarser grain, above noticed, sometimes in parallel seams between the layers of the rock, and sometimes in detached parallel patches, which are occasionally arranged, by a series of lateral shifts, in a direction obliquely transverse to the line of stratification. These patches of anthophyllite are sometimes accompanied with groups of small light red garnets, in a fine white granitic ground. The fine-grained variety is found only in the fine-grained more granitic rocks of the formation, particularly the uniform white felspathic variety; its place being apparently supplied in the fine-grained micaceous rocks, by a corresponding minutely spicular dark hornblende. Alternate beds occur, in connexion with the anthophyllitic rocks of the formation, of a uniform light grey, coarsish grained, thick sub-granitic gneiss, and a similar dark grey, finer grained sub-micaceous gneiss, in neither of which have I observed the presence of anthophyllite. These are usually very decomposable and ferruginous, from disseminated pyrites. This remark is also true of the rocks of this formation generally, particularly of the fine-grained micaceous and granitic rocks; the latter being most usually stained with bright yellow or orange tints, and the former presenting seams of steel blue or purple. The surface of the more ferruginous rocks of the formation occasionally pre-

sents extensive efflorescenses of white copperas. This was observed, in a remarkable manner, on the rocks near the source of the W. branch of the Hammonassett.

Beds of Hornblende are not unfrequent in the present formation, particularly in connexion with the dark micaceous sub-hornblendic gneiss. The Hornblende of these beds is usually less schistose than that in the ranges (†—‡,) afterwards noticed, accompanying the present formation, as lateral appendages, on the East and West, and like the dark sub-hornblendic gneiss, with which it is associated, is often thick bedded, and very decomposable, presenting a rounded surface to its beds, like that generally characteristic of the primary limestones. Beds or veins of coarse white, and more rarely reddish Granite, are abundant in some parts of the formation, particularly in that part of it passing through Haddam, by the meeting-house. In some parts of the formation, especially towards the S. W., beds of white granite occur, with large nests or patches of a singular coarse graphic structure, apparently peculiar to the formation. This variety was observed at Nut Plains, N. E. of Guilford borough, and in Black Rock (North Madison,) West of the Hammonassett. The coarse white talcose granite of Haddam, abounding in rare minerals (chrysoberyl, iolite, pinite,) is also situated within the limits of the present formation. The formation is also characterized, throughout a considerable part of its extent, by seams of a fine black tourmaline, occurring in granitic gneiss, arranged in a zig-zag form, in lines obliquely transverse to the direction of the stratification, and resembling in that respect, the arrangement of the darker variety of anthophyllite, above noticed. This obliquely transverse arrangement is also observable in a peculiar rather fine-grained blueish white felspathic rock, with a very tortuous but distinctly parallel structure, characterized by detached contorted seams or patches of coarse dark green mica, often succeeding each other in the same manner as the patches of anthophyllite. Large crystals of black tourmaline are not unfrequent in the granite of this formation, particularly in that of Haddam.

Magnetic iron, in large crystals, occurs in white granite in this formation, both in North Madison and Haddam. Beds of a light grey, rather coarse-grained, thick sub-granitic gneiss, abounding in garnets, occasionally occur, particularly near its Eastern border, towards the S. W., as at Nut Plains, N. E. of Guilford. This rock, from its softness, is easily dressed, but is apparently too decomposable to promise much durability. It is characterized by rather thick light grey micaceous seams, in which the garnets are usually included, marked by elongated scales of shining black mica, giving to them a peculiar aspect. A fine-grained thin even felspathic gneiss occurs in different parts of this formation, with similar elongated scales of dark greenish mica, very sparsely disseminated.

Along the E. side of that part of the formation, S. W. of the Hammonassett, is a large band or subordinate range (†,) apparently wider towards the South, extending through North Madison, and the adjoining part of Guilford, farther S. W., which may be considered intermediate between the present and the preceding formation (1.) I have not noticed the presence of anthophyllite within its limits, but the general character of its rocks corresponds more or less nearly to that of the rocks of the present formation. Granitic Gneiss is the predominant rock throughout this subordinate range, but with more frequent alternations of dark Micaceous Gneiss and Hornblende, than in the preceding formation (1.) Generally the rock immediately accompanying these alternations, is finer grained, and more ferruginous and decomposable than that more remote. The more common granitic rock of this range is usually finer grained than that of the preceding formation (1,) and at the same time more evenly arranged, usually with white, sometimes reddish felspar in thicker layers, with thinner seams of dark or light grey mica. Beds or subordinate ranges occasionally occur of a very felspathic variety, nearly pure white, on its weathered surface. The Hornblende of this range is generally fine-grained and thinly schistose. Along the Eastern border of this range, extends a band of considerable width,

particularly towards the S., of a thin grey micaceous very ferruginous gneiss, occasionally with plumbago disseminated. This is very decomposable, particularly in the S. part of its course, between N. and S. Madison, where very few ledges appear upon the surface. On the West side of this band, not far East of North Madison meeting-house, occurs a variety of less ferruginous grey sub-granitic gneiss, full of small lenticular white felspathic nodules, uniformly fine-grained and very hard, arranged in a parallel direction in the rock, like interrupted beds of granite, in miniature. This rock is accompanied with alternate beds and seams of a light red fine-grained garnetiferous quartz. In the line in which I have supposed the Anthophyllitic formation to be continued around the S. end of the preceding formation (1,) beds of a coarse grey sub-micaceous gneiss occur, with felspathic nodules, similar to those just mentioned, and with other smaller ones, resembling the talcose quartzy nodules noticed in connexion with the Quartziferous ranges (A 3 7 †—††.) This rock sometimes also includes thin detached layers of quartz with parallel seams of white fibrous talc, and alternates with darker more micaceous bands, with garnets.

Another range (‡,) usually of moderate width, may be traced along the Western border of the Anthophyllitic formation, at least from Guilford river, on the S. W., to the Connecticut in Maromus, and may be even still farther traced, adjoining that formation, on the N. and E., across Haddam Neck, again to the West bank of the Connecticut near Haddam courthouse, and thence S. apparently to the vicinity of Cedar Pond (Chester.) I shall at present only consider that part of it on the West, from Guilford to the Connecticut, in Maromus. This subordinate range consists of a thin even light grey sub-micaceous Gneiss, abounding in beds of Hornblende, and also with beds of coarse granite and granitic gneiss; the latter usually very fine-grained and even. The granite of this range is usually very coarse-grained and white felspathic, occasionally with veins of blue and white quartz, and with large crystals of black

tourmaline, as in the vicinity of Essex Turnpike (North Guilford.) Farther S., on the E. side of Guilford river, and on the immediate Western border of the Anthophyllitic formation, small bands of fine-grained black Tourmaline rock are met with, adjoining veins of crystalline quartz associated with coarse white granite. The Hornblende rock of this range, like that of the Eastern range (†,) is generally fine-grained and thinly schistose. Sometimes it presents seams of a coarser or finer spicular black hornblende, the coarser resembling anthophyllite in structure, and both often exhibiting a reticulated arrangement. It sometimes includes thin parallel stripes of very fine white felspar and light yellow epidote. In that part of the present range, extending at least from the Durham and Madison Turnpike, West of Black Rock, to the Connecticut, in Maromus, there occur, usually in its central part, beds of a very fine-grained, even, dark grey Micaceous Gneiss, with still more minutely fine-grained stripes of a beautiful red colour, and others equally fine, of a light blue. This rock alternates with the thin light grey Gneiss of the range, and with a dark thinly schistose Hornblende. I have observed it in all the sections I have made within the limits, above specified, and also on Haddam neck, adjoining the Anthophyllitic formation on the N. East, and on the Western border of the formation (C 2,) N. E. of Portland village. It occurs, too, on the East side of East river, N. E. of Guilford borough, in the interval between the Anthophyllitic formation and the adjoining Granitic range (†) on the East, and is perhaps allied there to the garnetiferous quartz in the latter range, E. of North Madison. Beds occasionally occur, on both the Eastern and Western borders of the present range (t,) of a coarser and thicker dark Hornblende, with nodules of epidote; sometimes anthophyllitic in its structure, particularly in thin interposed seams, and sometimes with alternate bands of a coarse tortuous dark green micaceous gneiss. At a point W. of Higganum, this rock is accompanied by a light grey even sub-granitic gneiss, with interposed flakes or patches of fine dark mica, giving the rock a

peculiar aspect. A similar rock occurs in the range, already alluded to as a probable continuation of the present, on the E. side of the Anthophyllitic formation in Haddam.

The present formation may apparently be traced E.—W., around the Southern border of the preceding formation (1,) passing N. of Madison village (1—2 miles,) where it is marked by the peculiar rock with felspathic and talcose quartzy nodules, and more rarely by the presence of anthophyllite, and farther E., by the gate on the Higganum Turnpike, N. of Clinton borough, where it presents an extensive series of the most peculiar rocks of the formation, some of them abounding in anthophyllite, and usually very ferruginous, with large beds of dark hornblende, often very decomposable, when more immediately adjoining the formation (1,) on the North. The rocks of the present formation there apparently form a process extending N. into the preceding formation (1,) on both sides of the turnpike. N. of Westbrook, a range of rocks resembling those accompanying the present formation, but in which I have observed no distinct traces of anthophyllite, occurs near where this formation apparently bends N. towards the point, already indicated, on the Essex Turnpike.

The S. Eastern Trap Dike, in the Eastern Primary, enters the present formation, on the S. W., at the summit of the ridge, E. of Quonipaug Pond (North Guilford,) whence it crosses it, in a nearly Easterly direction, parallel to the road leading to Black Rock meeting-house, on the South, and after having traversed the N. part of the Granitic formation (1,) again crosses it, in a N. N. E. direction, on Haddam Neck, S. of Middle Haddam.

3. *A Micaceous Formation* (Gneiss.)

This forms a band, usually of moderate width, extending along the Western border of the Eastern Primary, from the valley, N. of Branford village, already noticed in connexion with the first section (1) of the granitic formation (A,) to a point, about a mile N. of Connecticut river, East of Portland.

The Eastern border of the present formation, adjoining the Hornblendic range (‡) along the Western border of the preceding formation (2,) is generally marked by a more even line directed N. N. E, at least from Guilford river Northward. The Western border, adjoining the Secondary, is more undulating, giving a variable width to the formation, particularly in its Southern part. In the vicinity of Quonipaug Pond (North Guilford,) the formation is very narrow; the Hornblendic range (‡) approaching very near the frontier of the Secondary. West of Guilford river, the Eastern border of the present formation bears W. S. W. along the Northern border of the supposed S. W. termination of the Anthophyllitic formation in Moose Hill, and farther West along the N. border of the first section of (A,) to the valley North of Branford, above mentioned. At its N. termination, this formation apparently runs out in a point, between the Secondary, on the West, and a diluvial plain, on the East, separating it from the Western border of the formation (C 2.) Farther North, however, a narrow range (C 1,) of a similar character, appears on the W. side of the latter formation, and may be traced, with a few interruptions, Northward into Massachusetts.

The present formation consists chiefly of a rather dark grey, usually coarse-grained, very micaceous Gneiss, most frequently distinctly felspathic, but occasionally having more the quartzose composition of a Mica Slate; generally tortuous in its grain, with frequent small parallel veins of quartz and granite. This includes subordinate beds of a finer grained, more even, lighter grey sub-micaceous gneiss, generally breaking in flat jointed fragments. Alternate beds also occur of a nearly white, rather fine-grained, even, very felspathic gneiss, or parallel granite, usually breaking, also, in regular jointed fragments. These are most frequent in the middle part of the range, E. of North Guilford and Durham. Large interposed beds or veins of coarse white Granite are more or less frequent, throughout the whole extent of the formation. These are generally coarser grained than those accompanying any

other Primary formation in the State. A remarkable instance of this kind occurs at the Porcelain Quarry, S. E. of Middletown, on the summit of the Western declivity of the formation. A single mass of felspar was there found, weighing nearly five cwt., and sheets of mica are there observed 1—2 feet square. The granite of this formation, although so very coarse-grained, is generally distinctly parallel, and sometimes obviously porphyritic in its structure, and is usually arranged in lines of more or less detached beds, very obliquely transverse to the direction of the including micaceous rock, corresponding in this respect, to the arrangement of the porphyritic points of felspar in the porphyritic rocks of the Western Primary, as explained under the formation (D W.) The quartz of the granite of this formation is usually white and limpid, and occasionally large veins of similar quartz occur, as on the summit of the ridge, north of the Porcelain Quarry, above noticed. Along the immediate Western border of the formation, beds of granite occasionally occur, resembling that already noticed, in the same position, in the Granitic formation (A,) section (1.) The granite of these beds has more or less of a greyish tint, and presents the same indurated or altered appearance, noticed in the former instance, and like that, usually breaks readily in jointed fragments. These apparently indurated beds often contain seams of a dark, sometimes greenish chloritic mica, which in some instances is apparently converted into a black jaspoid substance, as if partially fused. This appearance may be observed in Branford and North Guilford, and at the Lead Mine, E. of Middletown. Small veins of blue quartz occur in this granite, and larger veins of blue quartz in the Micaceous Gneiss, in a similar situation on the Western frontier of the formation.

Along a considerable part of the W. frontier of the formation, from Bluff Head, Northward, extends a narrow band of a greenish Chloritic Micaceous Gneiss, often with red felspar, and sometimes, particularly on the immediate frontier, apparently more or less indurated. In the valley opening N. from Bluff

Head (S. of Durham,) along the Western border of the Primary, is a low ridge or swell, of a dark green, very hard and prismatic chloritic micaceous rock, which at first sight might be taken for Trap. It is situated at only a short distance from a ridge of light blue felspathic Trap, belonging to the Secondary. Beds of a lighter greenish micaceous gneiss, generally accompanied with hornblende and pyroxene, are occasionally interposed in the common grey micaceous gneiss of the formation, more remote from the frontier. A narrow band apparently extends along the immediate frontier of the formation, both N. and S. of the Connecticut, below Middletown, characterized by a very dark blue, more or less indurated and fragmentary micaceous gneiss, (marked by shining apparently chloritic seams,) often abounding in small veins of crystalline quartz, and sometimes with small rounded nodules of quartz, arranged in an interposed series, like porphyritic points of felspar. The Lead Mine, E. of Middletown, occurs in a quartz vein, connected with this rock. Beds of Hornblende are comparatively unfrequent in the greater part of this formation, but more abundant in that part of it S. W. of Guilford river, in Branford and North Branford. That part of the formation, too, particularly abounds in coarser and finer granitic beds, and in some parts, more especially at its S. W. termination, the micaceous rock is quite filled with small granitic veins and nests, forming, as it were, a mica-seamed granite-veined gneiss.

In that part of the present formation, between North Branford and Guilford river, extends a large subordinate range (¶,) chiefly composed of a coarse white Granite, generally distinctly parallel, connected with a finer grained stratified white felspathic granite, or granitic gneiss, and with slight micaceous alternations, particularly in its central part. This range is apparently in the line of the white granitic range (γ,) in the first section of (A,) continued N. Easterly, and like that too is sometimes accompanied with seams of white talc. It extends N. to the Secondary, W. of the Guilford and North Guilford road, and on the immediate frontier, presents the peculiar ap-

pearance of induration, with jaspoid seams and blue quartz veins, already noticed. In the micaceous gneiss, immediately W. of this range, beds of dark Hornblende are quite frequent, accompanied with beds of a light greenish fine-grained prismatic Pyroxenic Granite. Farther West, adjoining the W. border of the Primary, N. E. of North Branford village, is a tract, abounding in large beds of very coarse white Granite, either quite detached, or in long narrow ranges crossing the general direction of the formation obliquely N. W. The Micaceous rock of the formation is here generally very undulating and often nearly horizontal, and obviously includes the granite beds, in an interposed position; thin bands, usually of a finer grained sub-micaceous gneiss, and sometimes of a fine-grained felspathic or quartzose rock, being occasionally interposed, in a similar undulating manner, in the granite. East of this range of beds, in the range abounding in hornblende, just noticed, the micaceous gneiss is often highly contorted, sometimes obviously from its involution around detached granitic beds or veins. On the N. side of the valley, already noticed, terminating this formation on the S. W., is a series of ledges, presenting on the S. E. towards the Granitic Gneiss of (A 1 β,) a band of coarsely crystalline Hornblende; then a band of a light grey sub-granitic gneiss, with disseminated crystals of hornblende, somewhat resembling the peculiar rock of the next succeeding formation (4;) and on the N. W. the grey micaceous veined gneiss of the present formation, with beds of the coarse granite, peculiar to the Western frontier of the Primary.

The Trap Dike, already noticed, enters this formation, S. of North Branford, and traverses it in a direction nearly parallel to the Western frontier of the formation, (crossing the subordinate granitic range (¶) nearly transversely,) to a point not far S. E. of Quonipaug Pond (North Guilford,) whence it extends E. across the Anthophyllitic formation (2,) into the Granitic formation (1,) as already explained.

4. *A Sub-Granitic Sub-Hornblendic Formation* (Gneiss.)

This forms a narrow range, which may be traced along the S. border of the supposed line of the Anthophyllitic formation, on the S. of the Granitic formation (1,) and thence N. in a line East of the Anthophyllitic formation, to the Connecticut river, below Haddam court-house. The characteristic rock of this range, is a dark mica-seamed sub-granitic Gneiss, with parallel seams and disseminated crystals of hornblende, (the latter generally accompanying the parallel mica seams.) This rock is quite similar to that of class (γ) in (A 3,) and not unlike that of the range adjoining the Hammonasset, in the formation (B 1,) but is more distinctly sub-hornblendic. It is usually quite fissile, particularly where the micaceous or hornblendic seams are strongly marked, and from that circumstance is well calculated for flagging. Parallel seams or stripes, sometimes circumscribed in patches, of a rather fine white felspathic granite, with porphyritic hornblende disseminated, and interposed nests of a coarser granite, with large veined porphyritic points of bluish felspar, are not unfrequent in the gneiss of this range. Interposed beds, and more or less obliquely transverse veins of coarse, usually white granite, with beryls and tourmalines, occasionally occur. In some instances at least, in the transverse veins accompanying this formation, the parallel structure of the including gneiss can be distinctly traced across the veins, thus apparently indicating their cotemporary formation. Alternate beds occur of a lighter grey, more felspathic, and a darker, more micaceous, finer grained more uniform hard gneiss, also accompanied more or less with hornblende, particularly the darker more micaceous variety. The flagging quarries, at Haddam, situated in what is known as the Allen and Brainard vein, are in a large bed of the darker variety, traversing the Western border of the range, for some distance, from N. to S., on both sides of the Connecticut. This bed is accompanied by parallel beds of a dark grey, coarser, more micaceous and decomposable gneiss, with interposed bands of

Hornblende. Similar alternations may be observed farther S. in the present range, W. of Chester, and indeed, more or less, throughout its whole extent.

This formation commences distinctly towards the S. West, in the vicinity of Guilford borough, on the North, but perhaps may be traced farther West, in the S. part of the range (††,) noticed under the first section of (A,) where frequent beds of Hornblende may be observed as far West as Stony Creek (Branford.) From the N. of Guilford borough, this formation may be traced, apparently in a narrow uninterrupted band, and in an undulating direction, Easterly, in a line nearly parallel to the coast, to a point N. of Westbrook. In this part of its course it presents four well marked flexures; being first directed S. E. to East river, then E. N. E. to Madison village (W.,) then E. by S. towards the Hammonassett, then E. N. E. to a point N. of Clinton borough, and again E. S. E. to the point N. of Westbrook. From the latter point it bears North Easterly nearly to the Essex Turnpike, and then Northerly to the Connecticut, at the point above specified. It is apparently continued still farther North, in a Granitic and Hornblendic range (C 4,) bordering the Bolton Mica Slate range (C 3) on the East, to be noticed in connexion with the next succeeding group of formations (C.) The rock of this range is quarried not only at Haddam, but to some extent West of Chester, and at Madison and Guilford. The more granitic varieties are generally less frequently divided by transverse cleavages, and when with more distinctly marked mica seams, are often very fissile, sometimes forming thick even slabs of many feet in extent. The more micaceous sub-hornblendic varieties, from their great firmness, are peculiarly suited for curbing, for which purpose they are generally employed.

A narrow range (†) of a light grey, white felspathic Granitic Gneiss, less mica-seamed, and not characterized by disseminated hornblende, but often abounding in garnets, extends along the Southern border of the preceding range (4,) at least a part of the distance from Guilford, Eastward. It extends S. E.

from Guilford borough to East river, and may be traced along the coast road, West of the Hammonassett, and again from a point not far W. of the Menunketesuck, to Westbrook. In this part of its course it pursues a direction parallel to the preceding range (4,) and apparently adjoins immediately the granitic formation (A.) From Westbrook it bears E. N. E. along a rocky ridge, bounding the plain West of Saybrook village, on the North, nearly to the Haddam and Saybrook Turnpike. It there abounds in large and small contracting and interrupted, longitudinal or interposed veins of coarse white granite, and is often quite filled with large garnets, particularly adjoining the granite veins. Beds of dark green or black Hornblende also abound there, particularly along a line near the middle of the range, and are perhaps connected with a narrow band of Hornblende, West of Westbrook, accompanied with large beds of coarse white granite, and at times decomposing into a fine black sand. In the Eastern part of the ridge, N. W. of Saybrook, apparently adjoining the band of Hornblende on the S. E., commences a narrow range (‖) of a thin, fine-grained, uniform dark Micaceous Gneiss, which first bears E. N. E. to the Haddam Turnpike, South of Essex, and then curving around abruptly N. W., again bends N., passing by Pettipaug meeting-house, and West of Deep River village, to the S. branch of Chester brook, just West of Chester village. This range thus far forms quite a narrow band, apparently, however, uninterrupted, and serving as a guide in determining the contiguous less strongly marked ranges. Its direction obviously conforms to that of the Anthophyllitic and Sub-hornblendic ranges (B 2—4,) on the West, and to the West frontier of (A,) from Lyme Ferry Northward, on the East. At Chester brook, it suddenly expands towards the East, forming the commencement, on the S. W., of the formation (E 1,) traversing nearly the centre of the Eastern Primary, West of (A,) in a N. Easterly direction, into Massachusetts. The Granitic range (†) is apparently continued North, between this dark micaceous range on the East, and the range (B 4)

on the West, to the Connecticut. It appears distinctly, West of Chester, in a band of lighter grey more decomposable granitic gneiss, with garnets occasionally disseminated, and farther N., in the S. E. part of Haddam, in a wider range of a similar light grey granitic gneiss, occasionally alternating with a coarse dark micaceous small granite-veined gneiss, with garnets, and accompanied at times, particularly on its Eastern border, by large beds of a rather coarse dark green thick bedded Hornblende. It is continued still farther North, in the Granitic range, in which are situated most of the quarries in the Eastern part of Haddam Neck, adjoining there the Northern termination of the range (4) on the East, and like that is apparently connected with the Granitic range (C 4.) This band of light grey Granitic Gneiss (†) apparently expands in width from Chester Northward, while the Sub-hornblendic range (4) in a corresponding degree diminishes.

The Granitic rock of this range is usually more felspathic than that of the range (4,) and also thicker and less fissile, from its less strongly marked mica seams. These are usually less even and uniform than those of the latter, and present more or less distinctly the rounded sub-porphyritic structure of the mica seams in the Granitic formation (1.) Indeed the granitic rock of this range has a striking resemblance to that of the latter formation, both in composition and structure, although separated from it by at least two interposed ranges.

West of the Sub-hornblendic range (4,) at Brainard's Quarry, in Haddam, extends a range (‡) of moderate width, included between it and the Anthophyllitic range, and already noticed in connexion with the Hornblendic range (2 ‡,) adjoining the Anthophyllitic range on the West. This range is also continued N. of the Connecticut, in connexion with the group (C.) In that part of it South of the Connecticut, the predominant rock is a fine-grained, light grey, very even sub-granitic gneiss, generally very decomposable; partly marked by thin darker micaceous or hornblendic seams, and then usually very prismatic, and partly by parallel flakes or patches of a

fine dark mica, and then usually rather thinly fissile, and less divided by jointed cleavages. Occasionally there occurs, in connexion with this rock, a similar fissile, nearly white quartzy gneiss, not a little resembling the white Quartz rock connected with the Bolton Mica Slate range (C 3,) to be afterwards noticed. In the N. part of this range, particularly near Haddam court-house, is an extensive series of large beds of very coarse white Granite, with tourmalines, associated with a dark silvery shaded, very micaceous Gneiss, or Mica Slate, also allied to the Mica Slate of the Bolton range. This latter rock is much more abundant in that part of the range N. of the Connecticut, and is there, particularly, often very ferruginous and decomposable. On the W. border of this range, is a band with frequent beds of dark Hornblende, sometimes accompanied with pyroxene and epidote, and occasionally anthophyllitic in its structure. This closely resembles the Hornblende, with epidote, already noticed in connexion with the range (2 ‡,) apparently indicating a continuation of the latter along the outer border of the Anthophyllitic formation, to the present range. This latter may be traced South, at least as far as the vicinity of Cedar Pond, apparently soon running out in that direction.

It remains to notice the range (*,) already referred to under (A 3 3.) This forms a band, interposed between the Western boundary of the formation (A,) as marked by its frontier range of red felspathic rock (β,) and the S. E. border of the Micaceous range (E 1,) at least from the vicinity of Deep River, on the West, to a point S. E. of Salem village, on the East. The range of dark mica-seamed, more or less sub-hornblendic, subgranitic gneiss (A 3 2,) borders the dark micaceous range (‖) on the East, from near the Haddam Turnpike N. of Saybrook, at least to the vicinity of Essex; and a band of the same rock is apparently continued along the E. border of (‖,) by the S. W. point of (A 3 3,) opposite Mount Archer, to the vicinity of Deep River, at the commencement of the present range (*.) This consists chiefly of a light grey, dark mica-seamed subgranitic gneiss, with more or less of hornblende disseminated

in its mica seams; accompanied with alternate bands of a more uniform light grey sub-granitic, and darker grey sub-micaceous gneiss. The rock of this range very much resembles that of the Sub-hornblendic range (4,) and like that is often traversed by parallel and transverse granite veins. Occasionally it contains nodules or veins of pyroxene and epidote, and the latter frequently occupies the transverse cleavage seams. The rock in that part of this range, passing along the S. border of the Micaceous formation (E 1,) from Hadlyme to Salem, is generally quite hard as if it had suffered induration, and much broken in jointed fragments, particularly as it approaches that formation. The range apparently terminates E. of the New London Turnpike in Salem, in a narrow band, interposed between the S. W. point of the frontier red felspathic range (β,) connected with (A 3 ^{7},) and the main body of the formation (A.) The rock there contains frequent bands of Hornblende, and both that and the gneiss of the range occasionally abound in seams and nodules of epidote. Where the present range approaches the Micaceous formation (E 1,) it presents alternate beds of a light grey, coarse or fine-grained sub-granitic gneiss, with more or less of white or reddish porphyritic felspar disseminated in a uniform sub-porphyritic ground, and of a dark grey sub-micaceous, rather coarse sub-porphyritic gneiss. This arrangement is observed at Pettipaug, Chester and Hadlyme, and farther East, towards Salem. The quarries near the Connecticut, at Deep River, Chester and Hadlyme, are situated within the limits of the present range. The rock more usually quarried, particularly at Deep river, is the light grey even striped sub-granitic gneiss, most characteristic of the range, usually more granitic and less fissile than that of the range (4,) and more resembling that of the quarries of Haddam Neck, in the range (†.) The porphyritic rock, just noticed, is also quarried for similar purposes, S. E. of Chester village, and just S. of Comstock's Ferry (Hadlyme,) and also adjoining the dark micaceous range (‖,) near Pettipaug meeting-house.

Viewed in connexion, the present division (B,) the detailed account of which is now completed, presents a central Granitic formation (1,) surrounded almost or quite entirely by the Anthophyllitic formation (2,) and still less completely by the Hornblendic range (2 ‡,) continued in (4 ‡,) and by the Sub-hornblendic formation (4,) with its appended range (4 †.) Along the Western border of the whole extends the Micaceous formation (3,) continued farther N. along the Western border of the succeeding division (C.) The Anthophyllitic and Sub-hornblendic ranges apparently terminate on the S. W. in a point, penetrating between the ranges (γ) and (δ,) in the first section of (A,) while the former of these (γ) is apparently continued N. E. in the Granitic band (¶,) traversing the S. W. part of the Micaceous range (3.) Proceeding to the East, we observe the Micaceous formation (E 1) terminating on the S.W. in a long narrow process (‖,) passing S. and S. W. between the Sub-granitic ranges (4 †) and (4 *,) and farther N. W. we find the ranges (4) and (4 †,) continued N. in the Granitic range (C 4,) bordering the Bolton Mica Slate range (C 3) on the E., while the Bolton range *itself*, and a Granitic range (C 2,) between it and the continuation of the Micaceous range (3) in (C 1,) on the West, may be considered as commencing in the range (4 ‡,) which apparently terminates in a point W. of Chester, between the Anthophyllitic and Sub-hornblendic ranges (2—4.) These appearances would seem to indicate that the Eastern Primary System commences, as in a point, in that part of it W. of the Connecticut, and that the formations which compose the main part of it, are not fully developed, till farther N. E. It will be hereafter seen, that the more Northern part of the system offers a series of more extensive parallel ranges, with a general N. Easterly bearing, very similar, in their arrangement, to those of the Western Primary. Perhaps the extreme S. W. point of the Western System, beyond the limits of this State, offers an arrangement, conformable to that at the S. W. point of the Eastern System.

C.

Under this head, is included a group of formations, in a line North from the preceding group (B,) and apparently continued from the formations or ranges (3—4 ‡—4—4 †,) of the latter. The two central and most important of these formations, namely, the Bolton Mica Slate range (C 3,) and the Granitic range (C 2,) West of it, are properly included wholly within the limits of the present group, only rocks having a less immediate affinity to them, being found in the range (B 4 ‡,) but at the same time sufficiently allied to denote the direction of those formations, in their general relation to the whole Eastern System. This group consists of a narrow range of Micaceous and Chloritic rocks (C 1,) along its Western border, immediately adjoining the Secondary, continued from (B 3 ;) a wider range of Granitic rocks (C 2 ;) a narrow range of Mica Slate (C 3 ;) and a range of Granitic and Hornblendic rocks (C 4,) continued North from (B 4—4 †,) along the Eastern border of the group. The relations of these formations to each other, and to the general system, will be better explained, after a more detailed description.

1. *A Micaceous and Chloritic Formation* (Gneiss.)

This forms a narrow range, extending along the immediate Western border of the Eastern Primary, from a point near the North Chatham and Marlborough Turnpike, Northward into Massachusetts. It commences at a point N. N. E. from the N. point of the Micaceous formation (B 3,) and in the same line of direction, separated only by the Diluvial plain, already noticed. It is not apparent along the whole line of its course, being either interrupted, as is most probable, at least in some instances, or concealed by Diluvium. It forms, however, an uninterrupted range, from its Southern termination to a point N. of Roaring Brook in Glastenbury, and again may be traced West of Vernon, from a point S. of the Tankerooson, nearly to the Hockanum. It is again apparently interrupted, East of Elling-

ton, but re-appears in the N. part of that town, and extends, in an uninterrupted range, through Somers, at least to the Scantic, W. of South Wilbraham village, and is undoubtedly continued in the same relative position farther North. From near the N. line of the State, Northward, it apparently occupies the greater part of a narrow mountain ridge, immediately adjoining the Secondary, continued far N. into Massachusetts.

This formation is characterized by two leading rocks, namely, a darkish grey, usually coarse and tortuous, veined Micaceous Gneiss, sometimes approaching a Mica Slate, and very similar to the characteristic rock of the formation (B 3,) and a dark green Chloritic Gneiss, with more or less of hornblende disseminated, and more nearly allied to the Chloritic Greenstone of the formation (A,) in the Western Primary, than the green Chloritic rocks along the Western border of (B 3.) More usually the Chloritic Gneiss forms a distinct band, on the Western border of the range, and the Micaceous Gneiss another, adjoining the Granitic formation (2,) on the East; but occasionally they occur interstratified. Beds of Hornblende, and veins or beds of coarse Granite, generally accompany the rocks of this formation; the latter, more particularly the Micaceous Gneiss. The granite accompanying that rock, is generally very coarse-grained, often with a distinctly parallel, sometimes veined porphyritic structure. Its beds are also generally interposed, ranging nearly in the line of direction of the formation. It usually consists of white felspar, like that in the formation (B 3,) with only occasional disseminated points of reddish felspar, in a white felspathic ground.

In that part of the formation, from its S. point to Roaring Brook, the Chloritic and Micaceous rocks form two narrow parallel bands, in the relative position above stated, apparently continued through the whole distance. Beds of dark green Hornblende, and of prismatic Chloritic Greenstone often occur in the former, and of darker Hornblende, in the latter. Very large interposed beds of coarse white granite occur in connexion with the Micaceous Gneiss, and beds of a finer

grained, apparently indurated, greyish white granite or granitic gneiss, in the Chloritic range. The quartz of the granite accompanying the latter range is usually of a bluish or greyish tint, and in its fracture somewhat resembles hornstone. Quartz veins, of a similar character, also occur in the same range. In the S. part of this section, a large bed of a fine-grained light grey granitic gneiss, breaking in regular jointed fragments, occurs in connexion with the micaceous gneiss of the formation, which also there includes beds of a reddish veined porphyritic gneiss. From near Roaring Brook, on the North, to Vernon, the present formation is either interrupted or concealed by Diluvium. That section of the formation, West of Vernon, is chiefly composed of the green chloritic gneiss, with occasional beds of the grey micaceous gneiss, and also with beds of dark green Hornblende and light greenish granitic or sub-granitic gneiss; the last composed of a finer or coarser rounded sub-porphyritic white felspar, with more or less of green flaky chlorite disseminated. The Chloritic rocks of this section are usually much divided by jointed cleavages, particularly the granitic variety; the ledges of the latter breaking, on the surface, in flat prismatic blocks. Large interposed beds occur of a peculiar dark grey or reddish brown ferruginous Granite, chiefly composed of quartz, with a smaller proportion of white felspar disseminated, and even passing into quartz, usually breaking in small jointed fragments, and much intersected by seams or veins of white or limpid quartz, often abounding in geodes; resembling in this respect the rock of Lantern Hill, already noticed. It is often much intersected too by seams of specular iron, and contains frequent traces of copper (yellow pyrites, and green carbonate.) Farther S., on the immediate frontier of the Primary, in Manchester, occurs a band of rock, connected with the Granitic formation (2,) also much intersected by seams of specular iron, and with frequent traces of copper. Excavations have been made in search of copper, both at this locality and at Vernon (S. of Dobson's Factory.) In the more Northern section of this for-

mation, extending through Somers and South Wilbraham, the prevailing rock is the coarse dark micaceous veined gneiss, often very tortuous. It is accompanied not unfrequently with beds of dark green Hornblende, particularly on its Eastern border, towards the Granitic formation (2.) Beds of coarse white granite and of granitic gneiss are not unfrequent also. In its S. part, near the S. line of Somers, it is accompanied with large interposed beds of a very coarse white, distinctly parallel granite, sometimes presenting a veined porphyritic structure, with parallel undulating seams of white mica. Occasionally beds occur, in the micaceous gneiss, extremely ferruginous and decomposable, from the presence of pyrites. Only indistinct traces of the green chloritic gneiss are observed in connexion with this part of the formation. It, however, occurs on the Western declivity of the high ridge, above noticed, near the N. line of the State, W. of the micaceous gneiss, which there forms the main body of the formation.

The Chloritic rocks of this formation, as well as of (B3,) are generally more distinctly felspathic than those of (A W.,) but in those of the present formation, varieties frequently occur very similar to some of the rocks observed in the latter formation. Thus in the range S. of Roaring Brook (Glastenbury,) a green chloritic schist occurs, marked by delicately fibrous or spicular seams, resembling those in a variety of dark green Chlorite Slate, occurring particularly near the Western border of (A W.) This rock alternates with a thinly schistose dark green, finely spicular Hornblende, analogous to that of (C1W.) Beds also occur of a thick bedded dark green Chloritic Greenstone, partly minutely white sub-porphyritic, and partly uniform and compactly fine in its grain; the latter very similar to a trap-like variety occurring in the Greenstone range (A1W.) The Chloritic rocks of this formation are not only more felspathic, than those of (A W.,) but are occasionally distinctly sub-micaceous, and alternate too with dark grey micaceous rocks, usually finer grained and more even than those of the proper Micaceous range of the formation. Granite veins,

usually finer grained and more indurated than those of the Micaceous range, and sometimes reddish felspathic, and also beds of granitic gneiss, usually more or less sub-chloritic, are not unfrequent in connexion with them. These circumstances indicate their more immediate relation to the Eastern Primary, while the resemblances, above noticed, perhaps point out a connexion with the Western Primary, through the medium of the Chloritic formation (AW.) This latter formation may perhaps approach the Granitic formation (A E.,) continued farther W. S. W. across the entrance of New Haven Harbour, thus presenting a relation, similar to that of the Hornblendic-Chloritic formation (F 3 E.) to the same Granitic formation (A E.)

2. *A Granitic Formation* (Gneiss.)

This forms a range of greater width than any other in the present group, and extends Northerly, between the former range, on the West, and the Bolton Mica Slate range (3,) on the East. The predominant rock, throughout the entire formation, is a Granitic or sub-granitic Gneiss, presenting a number of varieties, in different parts of its extent, but with some general traits of resemblance in all. The character most distinctive of the Granitic Gneiss of this range, and by which it is particularly distinguished from that of the range (4,) E. of the Bolton range (3,) as well as from that of the Granitic formations connected with the group (B,) is founded in the arrangement of its mica seams. These, in the rock of the present formation, generally present more or less detached flakes or patches of dark mica, resembling those in the seams of the sub-granitic gneiss, accompanying the ranges (B 2 ‡) and (B 4 ‡,) while in the granitic gneiss of (C 4) and (B,) the mica seams are generally uniform, and more or less marked by small round sub-porphyritic points of felspar. The Granitic rock of the present formation, appears first distinctly, towards the S., near the line of Haddam and Chatham, on Haddam Neck, and on the W. side of a valley opening S. E. from Middle Haddam meeting-house, along the N. E. border of the Anthophyllitic

range (B 2.) Farther S. E., in nearly the same line, and adjoining the latter range, occurs a locality of the red striped gneiss, noticed in connexion with (B 2 ‡,) and still farther S. E. a range of Hornblende with epidote, similar to that noticed under (B 2 ‡) and (B 4 ‡.) From the point, above noted, the present formation extends N. N. W., in a narrow band, along the E. side of the Connecticut to Middle Haddam Landing, bordered on the E. by a similar narrow range of the dark silvery Micaceous Gneiss (or Mica Slate,) with large beds of coarse white Granite, already noticed in connexion with (B 4 ‡.) Farther N., namely, W. of the S. point of the Bolton range, the formation assumes its average width, and is directed more N. N. Easterly, conformably to the direction of the latter range on the East. This formation may be considered as divided into two parts by the basin of Snipsick Pond, N. of Vernon; the two sections presenting, in the character of their rocks, sufficient differences, to entitle them to a separate description.

1. The Southern Section, including all that part of the formation extending N. from Middle Haddam, through Glastenbury, Manchester and Vernon, to Snipsick Pond, may be divided into two subordinate ranges, distinguished by the peculiar character of their rocks.

α. The Western part of the section, and in some points apparently its entire width, is chiefly occupied by a darker grey, more strongly mica-seamed, veined sub-porphyritic granitic or sub-granitic gneiss, with crystals of hornblende more or less disseminated in the mica seams, and with stains or patches of light yellow epidote, more or less diffused through the felspar. This latter trait gives a peculiar character to the rock of this division, which, from this circumstance, might not inaptly be called an Epidotic Granitic Gneiss. It also forms a connecting link, between the present formation, and the band of Epidotic Hornblende, adjoining the outer border of the Anthophyllitic range, in (B 2 ‡—4 ‡.) Large and small interposed nests or patches of dark hornblende, and of a fine-grained uniform light grey sub-granitic gneiss, not unfrequently occur in the

granitic gneiss of this division. These are usually of a lenticular form, and are often arranged in a series, in the line of stratification, as has been noticed of porphyritic points of felspar, and detached beds of granite, apparently indicating a common principle of formation. Alternate beds of a dark micaceous subhornblendic gneiss, usually very decomposable, and of dark Hornblende, occur in this division, and also beds of coarse red and white granite, and of a finer grained felspathic granitic gneiss. Very large beds of an extremely coarse granite occur on the immediate Western border of this division, at the Roaring Brook (Glastenbury,) resembling in grain, the granite of the Felspar Quarries, S. E. of Middletown, in (B 3.) Occasionally, along the Western border, particularly adjoining the green chloritic gneiss of (C 1,) as in Vernon, and at other points, where the preceding formation (C 1) is not apparent, as E. of Manchester, a light green chloritic tint pervades the rocks of this division, accompanied with red felspar. The granitic gneiss is there frequently porphyritic in its structure. In the S. E. part of Manchester, on the immediate frontier of the Primary, is an extensive excavation for copper, in a rock of this description. The mine is entered by a nearly horizontal gallery, first dug through a coarse granitic conglomerate, and soon meeting the granitic gneiss of the present formation, which is there apparently much indurated, and pervaded by seams of specular iron, accompanied with purple iron stains and traces of copper. Along the high ridge in Eastbury, between the frontier of the Primary and the valley of the North branch of Roaring Brook, extends a subordinate range of a lighter grey more granitic gneiss, rarely epidotic or hornblendic, and occasionally with reddish porphyritic felspar. Towards the S. extremity of the present formation, South from Middle Haddam Landing, there generally occurs a series of alternate beds of a light greenish grey reddish porphyritic gneiss, and a dark greenish micaceous sub-hornblendic gneiss, with occasional beds of dark green hornblende, and others of a coarse or fine-grained granitic gneiss, usually with reddish felspar. At the

extreme S. point, the more granitic rock of the formation approaches more nearly the even fine-grained sub-granitic gneiss, with parallel flakes of dark mica, noticed under (B 2 ‡—4 ‡,) but still with some degree of the porphyritic structure, observed farther Northward. Not unfrequently, throughout the present division, a band of a white or reddish porphyritic gneiss occurs on its immediate borders, both Eastern and Western, particularly the latter. The occurrence of a narrow range, including beds of the red striped gneiss of (B 2 ‡,) along the Western border of this formation, E. of Portland, has already been noticed. This adjoins, on the E., a band of porphyritic rock, interposed between it and the peculiar rock of the present division (α.)

β. A range of a very light grey, sometimes nearly white, rather coarse-grained felspathic Granitic Gneiss, extends along the E. border of the present section, where it adjoins the Bolton Mica Slate range (3,) apparently throughout the greater part, if not the whole, of its extent. The rock of this range is usually very slightly seamed with mica, and is often porphyritic, both with felspar and quartz; the porphyritic character of the latter very exactly resembling that of the former. This rock occasionally alternates with a fine-grained light grey, less granitic gneiss, more distinctly seamed with dark mica, like the rock of the preceding division (α,) but rarely accompanied with epidote. This range is of greatest extent towards the S. in Chatham, and the S. E. part of Glastenbury, but may be traced N. as far as the S. E. border of Snipsick Pond.

2. The Northern Section includes that part of the formation from Snipsick Pond and its outlet in Hockanum river, on the S., to the most Northern point examined by me, W. of Monson (Mass.)

The Western division (α) of the preceding section may be regarded as continued N. in a comparatively narrow range (†,) traversing the ridge W. of Snipsick Pond, and farther N. presenting a more elevated line of summits, extending nearly parallel to the W. frontier of the Primary, to the North line of

the State, where it bends abruptly West, into the high narrow ridge, W. of South Wilbraham, noticed under the preceding formation (1.) The two highest summits in this range, Durfee's Mountain and Bald Mountain, on the S. and N. of the Stafford Turnpike, E. of Somers, form conspicuous objects, on the E. border of the Connecticut valley. In the South part of this range, the prevailing rock is a thin dark mica-seamed, more or less epidotic stained gneiss, more nearly allied to that of ($1\,a$.) Farther N. (E. of Somers, where it apparently occupies the line of summits above noticed,) the rock is rather less mica-seamed, and rarely presents any traces of epidote, but alternates with frequent large beds of a fine-grained dark Hornblende, abounding in nodules of fine yellow epidote, very similar to the Epidotic Hornblende of (B 2 ‡—4 ‡.) Large interposed beds of coarse white granite also occur in this range. Along the E. side of Durfee's Mountain (on its Eastern border,) is a large bed of a light greenish grey Talcose Slate, accompanied with a light green Actynolite Slate, and more or less filled with hornblendic asbestos; interposed between large beds of a dark green or black thick bedded sub-porphyritic Hornblende. The Talcose Slate has been worked as soapstone, but is generally of an inferior quality, from its too schistose structure, and from the presence of hornblendic asbestos.

The main body of the present section (‡,) East of the line of summits above noticed, is chiefly composed of a light grey, slightly uneven, usually coarse-grained Granitic Gneiss, marked by parallel flakes, rather than continuous seams of black mica. This rather resembles the rock of the Eastern than that of the Western division of the Southern Section ($1_,$) but usually wants the porphyritic quartz of the former, and is generally more dark mica-flaked and decomposable. A variety very similar to that of the Eastern division of ($1_,$) with porphyritic quartz, occurs on its Eastern border, near the line of the State, in Stafford, and farther North, E. of South Wilbraham. In the same part of the present section occurs a variety of dark thick bedded Hornblende, with small round porphy-

ritic nodules of white quartz, giving it a singular varioloid appearance. A variety of granitic gneiss, with large porphyritic felspar, also occurs in the same part of the section.

Along the S. border of the main body of this section (‡,) North of Snipsick Pond, a range of large beds of coarse white Granite (*) apparently extends round from E. S. E., on the West, to E. N. E., on the East, accompanied with a very fine-grained, light grey, ferruginous, decomposable Granitic Gneiss, with frequent interposed beds of a fine-grained, dark Hornblende, also very decomposable. At the S. W. point of this range, apparently exterior to it, and adjoining the Western range of the present section (†,) is a band of a rather coarse-grained, very white felspathic Granitic Gneiss, with seams of coarse green mica, usually very much contorted and interrupted. This rock resembles a similar variety noticed in connexion with the Anthophyllitic formation (B 2.) This range of decomposable Granitic Gneiss, with Granite and Hornblende, apparently extends N. along the E. border of the formation, at least to the Stafford Turnpike, where on its E. border the coarser Granitic rock, with green mica, is also observed. Farther North, beds of a dark fine-grained decomposable Hornblende, accompanied with a similar fine-grained decomposable Granitic Gneiss, occur in the more central part of the formation, at least from the County road, so called, to the N. line of the State. North of the latter road, near the E. border of the formation, is a range of a coarse sub-porphyritic thick bedded light green Hornblende, somewhat resembling the Chloritic Hornblende rock of Preston (F 3.) The range of decomposable gneiss with granite, on the North of Snipsick Pond, apparently curves round the Eastern more granitic part of the present section (‡,) on the South, separating it from the Southern section, and is then continued North, along its Eastern border. Still farther North, near the line of the State, it apparently extends in a range W. of the Granitic band, characterized by its porphyritic quartz and felspar, adjoining the Mica Slate formation (3) on the East. This

latter might be considered as a continuation of the range of similar rock in the S. section ($^1\beta$.)

The present formation apparently commences in the ranges (B 2 ‡—4 ‡,) included in the preceding group, with which it is connected by its Epidotic Hornblende, and the prevalence of epidote in the granitic rock of ($^1\alpha$,) as well as by certain peculiarities of structure, already referred to. Still the main body of the formation terminates distinctly towards the South, at the point S. of Middle Haddam, already pointed out, only more remote relations being observed farther South. The formation might be considered as composed of three detached subformations, namely, the Epidotic Granitic range ($^1\alpha$,) having its centre in the S. W. part of the formation, and running out towards the North, in the narrow band (^{2} †,) on the Western border of the formation, characterized by the prevalence of Epidotic Hornblende; the white granitic range ($^1\beta$) on the East, characterized by its porphyritic quartz, extending apparently in an interrupted series, along the W. border of the Mica Slate formation (3 ;) and the coarse dark flaked granitic range (^{2} ‡,) occupying the central portion of the Northern section, and separated from the two preceding ranges on the South and East, by the narrow band of decomposable granitic gneiss and white granite, noticed in connexion with it. The two first or more Southern of these ranges thus enclose the third or Northern range, on the West and East, by processes extending from their main body towards the North, in a manner already exhibited in more than one instance in the Western Primary. The porphyritic rocks of this formation present an arrangement worthy of notice. They occur generally in the narrow point, at its Southern termination, but farther North, are chiefly confined to its Eastern and Western borders, particularly to the Western border of ($^1\alpha$,) and to the range ($^1\beta$,) and its continuation Northward along the Eastern border of (2.) In the latter, quartz very generally takes the place of felspar in giving the porphyritic structure, thus indicating the relation of that range to the Quartz rock of the adjoining Mica Slate formation (3,) as will afterwards be noticed.

The N. W. Trap Dike, connected with the Eastern Primary, commences in the Southern section of the present formation, near it Western border, in the S. part of Vernon, and extends N. nearly in a line parallel to the W. frontier of the Primary, to the S. E. point of Durfee's Mt., when it bears more N. Easterly, obliquely across the Northern section, till it enters the Bolton Mica Slate range, near the North line of the State, in West Stafford.

3. *The Bolton Mica Slate Formation.*

This extends N. N. Easterly, in a high narrow ridge, continued, with only a few slight interruptions, from the Cobalt Mine, in Chatham, at least to a point N. W. of Monson (Mass.,) forming apparently the most extensive continuous Primary mountain range in the State. During the whole distance, above stated, it is only at two points intersected by valleys, dividing it to its base, namely, at Dark Hollow, N. W. of Marlborough, and at West Stafford, where the West branch of the Willimantic passes through from the preceding formation (2,) on the West. These two, and Bolton Notch (at a more considerable elevation,) cross the ridge nearly directly transversely (from East to West.) Other valleys cross it in a more Northerly direction (N. N. W.—N. N. E.,) caused by a lateral shift in the range.

This formation appears as a narrow Micaceous band, between two parallel Granitic ranges (2—4.) Throughout its whole extent, the predominant rock is a soft dark or light bluish (lead) grey Mica Slate, with garnets and staurotides, and more rarely with kyanites. Large staurotides occur in a band, along the Western side of the range, West of Bolton and Tolland. The prevailing variety of Mica Slate is generally coarse-grained, thin and uneven, with a predominance of mica, but thicker and more even quartzose varieties occur, in different parts of the range. Thus, at Dark Hollow, and on the summit of the ridge West of Bolton, a dark grey, less fissile and softer variety occurs, quarried as a firestone, and at

the latter point for grindstones. Along the East border of the range, North and South of the Bolton Notch, are extensive beds of a rather thick, light grey, even and very fissile sub-quartzose Mica Slate, in which are situated the noted flagging quarries of Bolton and Vernon. These beds are accompanied by a softer, more uneven, and more micaceous, light silver grey Mica Slate, marked by greenish shades or patches, like the Mica Slate of (C 1 W,) and in some of the beds, as in that adjoining the Notch, by a thin band of limestone, associated with hornblende and green pyroxene. Along the Western border, subordinate beds occur of a very hard, dark blue, thick, sub-quartzose Mica Slate, with garnets and staurotides. On the E. and W. borders, particularly in the North part of the range, beds occur of a very dark blue, softer Mica Slate, generally very ferruginous, and not unlike the dark blue ferruginous Mica Slate, accompanying the Hematite ores in Salisbury (M W.) The two latter varieties are usually very fine-grained.

Large beds or subordinate ranges of white Quartz rock occur throughout the greater part of the range. Along the Western border, this rock may be traced, with occasional interruptions, from the South point of the range, into Massachusetts. It occupies the greater part of the summit of the main ridge, at its Southern extremity (Great Hill,) and at the North line of the State forms another wide band, traversing the highest summit in the direction of the range (N. N. E.) The rock in this line is chiefly composed of a rather coarse-grained, white crystalline quartz, with more or less frequent seams of white mica, and with occasional porphyritic points of a more limpid quartz; the latter resembling not a little the porphyritic quartz in the Granitic Gneiss on the Eastern border of the preceding formation (2 1 β.) This rock is occasionally fissile in large even slabs, well-suited for flagging, and is quarried for such purposes in West Stafford. Subordinate beds occur in this rock of a more compact white or light grey quartz, breaking in large square blocks. This is particularly observ-

ed at the South extremity of the range. Occasionally this Quartz rock is bordered by a thick, dark grey quartzose micaceous rock, similar to that occurring in Dark Hollow, already noticed. On the Eastern border of the range, N. E. of West Stafford meeting-house, is a subordinate range of a very fine-grained, even, pure white Quartz, generally thinly fissile, with delicate seams of white mica; quarried to some extent as a lining for furnaces, and for other uses as a firestone. S. of West Stafford meeting-house, a bed occurs of a singular dark and light striped Micaceous Quartz, usually fine-grained and decomposable, and often exhibiting a distinctly porphyritic veined structure. The Quartz rock of this range is generally more or less ferruginous (pyritiferous.) In a large bed of it, on the summit of the range, E. of Square Pond (Ellington,) seams occur of a light red Hematite, formerly worked to some extent for the Stafford furnaces. The ore is apparently too much disseminated through the rock to be worked to advantage. It is undoubtedly formed, like the Hematite of Salisbury, by the decomposition of the iron pyrites disseminated through the rock. It is the only instance in which I have observed any quantity of this ore in the Eastern Primary. Veins of crystalline Quartz occasionally occur in this range, but rarely of any magnitude.

Beds or veins of coarse white Granite are not unfrequent in this range, generally associated with the coarser more micaceous variety of the Mica Slate. These are large and very abundant in that part of the range, W. of the quarries, in the vicinity of the Bolton Notch. In some parts of the formation are large beds or subordinate ranges of a peculiar very fine-grained, light bluish grey Granitic Gneiss, usually with a predominance of quartz in its composition, and often very ferruginous, with bright red and yellow stains. This occurs most extensively on the Eastern border of the range, North of Tolland, where it alternates with a dark blue ferruginous Mica Slate, sometimes containing nodules of a peculiar radiated hornblende.

Beds of Hornblende rock rarely occur in the more central part of the range, but are frequent on the Eastern and Western borders, particularly the Eastern, where they form a subordinate lateral range (†,) often of considerable width. The Hornblende in the interior and on the Western border is usually dark and thinly schistose, and in the latter situation, near the N. line of the State, it alternates with the dark blue ferruginous Mica Slate, already noticed. In the range (†,) on the Eastern border, the Hornblende is generally thick bedded and sub-porphyritic (sienitic,) dark green or black, and usually ferruginous and decomposable. It is there generally more or less accompanied with green pyroxene and epidote, in seams and nodules, and also with interrupted seams of coarse green mica, usually very tortuous. It is often accompanied too with large and small beds of coarse and fine white Granite; the fine-grained particularly, sometimes with seams of the same green mica, above noticed, and very similar then to the Granitic rock on the S. and E. border of the Northern section of the preceding Granitic formation (2,) as well as to a peculiar rock accompanying the Anthophyllitic formation (B 2.) Small beds of a dark grey impure micaceous Limestone occasionally occur, in connexion with the Hornblende on the E. border of the present formation. This Hornblendic range is very remarkable for its extent and peculiar character, at Dark Hollow, between Tolland and Vernon, and in Stafford, from the vicinity of the Firestone Quarry, above noticed, to the N. line of the State. In that part of it, E. of Vernon, is a large bed of black Tourmaline rock, with veined porphyritic quartz.

The general dip of the strata in the present formation is West; consequently the Hornblendic range, on the East, underlies the Mica slate forming the main body of the formation. This Western dip also renders the working of the Bolton flagging quarries, all of which lie on the E. side of the range, peculiarly inconvenient, and perhaps ultimately impracticable.

The present formation properly commences, on the South, in the bold S. point of the Bolton range, called Great Hill, N.

of Middle Haddam Landing. The high point of the ridge is there composed of the wide band of white Quartz rock, already noticed, while along the E. declivity, the peculiar Mica Slate of the range commences. The Cobalt Mine is situated at this point, in the latter rock, in an interposed bed of dark green Hornblende, accompanied with light green actynolite and arsenical iron. Farther S. extends, in a S. S. E. direction (that of the Bolton range being N. N. E.,) a narrow range (t) of a dark silvery thin Micaceous Schist, usually very ferruginous (pyritiferous,) and not unfrequently containing garnets, and sometimes patches of radiated hornblende. This range usually abounds in large interposed beds of very coarse Granite, forming almost a continued series, and connected with the granite beds in the same line, in the vicinity of Haddam courthouse. Beds of dark Hornblende also occur in this range, particularly near its E. border, sometimes thinly fissile, and at other times, thick bedded and sub-porphyritic. This Micaceous range occupies the greater part of the interval, on Haddam Neck, between the Anthophyllitic range (B 2) on the West, and the Granitic formation (C 4) on the East; being separated from the former by the apparent continuation of the preceding Granitic formation (C 2.) The connexion of this Micaceous range with the range (B 4 t,) has already been indicated.

The present formation, in the character of its rocks, and in its accompanying minerals, belongs to the same class as (C—E—G—M,) in the Western Primary, but differs from either of those by the abundance and peculiar character of its Quartz rocks. It more nearly resembles the Mica Slate range (E 6,) the only other formation of this class in the Eastern Primary.

4. *A Granitic Formation* (Gneiss.)

This forms a narrow range, of variable width, as will be observed, by reference to the map accompanying this report, extending along the Eastern border of the Bolton range (3,) throughout its whole extent, as far as examined by me, and farther S. along the E. side of the Micaceous range (3 t,) last

noticed, till it connects with the Granitic and Sub-granitic ranges (B 4 †—4,) at the Eastern quarries of Haddam Neck. This connexion, on the S., can be very distinctly traced N. N. Westerly, along the high ridge, extending through the E. part of Haddam Neck, and by the W. side of the valley of the W. branch of East Hampton brook, to the S. E. point of the Bolton range at Great Hill. The present formation then extends N. N. Easterly, along the East side of that range, rarely exceeding a mile in width, and sometimes quite narrow, merely occupying the lower part of the declivity of the range, and immediately underlying the Hornblendic band (3 †,) already noticed.

This formation consists of alternate beds of darker and lighter grey, more or less dark mica-seamed Granitic or sub-granitic Gneiss; usually quite even, and presenting in its mica seams, nearly the same sub-porphyritic appearance, already noticed under (B 1.) Occasionally the darker seamed varieties are sub-hornblendic, like the sub-granitic gneiss of (B 4.) The Granitic Gneiss of this formation, particularly in the more Southern part, is usually decomposable, but occasionally beds occur, sufficiently durable, and well fitted for quarrying. It is quarried to a considerable extent, in Marlborough (E. of Dark Hollow,) and in Tolland, Stafford, and Monson (Mass.;) but more extensively at its S. termination, at Haddam Neck, and in that part of its course, East of Middle Haddam. Occasionally, as it approaches the Hornblendic range (3 †,) on the West, it is very fine-grained and even, lighter and darker striped, and also very hard and prismatic, resembling, in that respect, the rock of the Sub-granitic range (B 4 *,) as it approaches the Micaceous formation (E 1.) This peculiar character was observed in it very strikingly on the Eastern declivity of the Bolton range, at a point N. E. of the North Quarry (Vernon.) It alternates, more or less, with beds of a dark sub-micaceous, occasionally sub-hornblendic, decomposable thick gneiss, which E. of Tolland village, forms, as it were, a subordinate range, on the E. border of the formation. Beds of a dark schistose

Hornblende also occur, particularly in connexion with the sub-micaceous gneiss, just noticed, both in the more central part of the formation, and on its Eastern border. In the latter situation, the Hornblende is occasionally thicker and sub-porphyritic. These dark Micaceous and Hornblendic beds are generally quite ferruginous, and the Granitic Gneiss adjoining them is usually finer grained and more decomposable. It may here be observed that Hornblende is generally more abundant along the line of junction of different formations, particularly those of a more distinct character, as micaceous and granitic formations. This is particularly observable of the present formation, where the Hornblendic range (†) extends along its line of junction, on the West, with the Mica Slate formation (C 3,) while on its E. border, adjoining the Micaceous formation (D,) there is a similar, though less remarkable predominance of Hornblende. In the quarries at Haddam Neck, and at other points farther North, in this range, thin beds occur of a ferruginous micaceous gneiss, with anthophyllite disseminated. This mineral, however, is in very small quantity in the present formation, compared with its great abundance in the Anthophyllitic range (B 2.) Beds or veins of coarse Granite are less frequent than in the Micaceous formations, adjoining. In that part of the range, E. of Bolton Notch, a singular variety of coarse granite occurs, with large veined porphyritic points of green felspar. Nodules of magnetic iron occur in a coarse white granite, near the Eastern border of the range (N. E. of Tolland.)

In the S. part of the present formation, from E. Hampton to the N. part of Marlborough, it extends to a considerable width through the lower country, E. of the Bolton range. Farther N. (to the S. part of Tolland,) it is usually quite narrow, scarcely extending beyond the base of the E. declivity of that range. At the latter point, between Tolland and Vernon, this and the preceding formation make a remarkable bend to the East, and again bear N. N. E. near Tolland village. At this last point, the present formation assumes a more consid-

erable width, which it retains to the most Northern point examined by me. From the W. branch of the Willimantic, to some distance beyond the N. line of the State, it extends along a wide valley, parallel to the Mica Slate range (3,) which there forms a high mountain ridge rising abruptly on the West. Farther North it extends along a more elevated tract, in Monson (Mass.,) adjoining the still higher ridge of the Bolton range (3,) on the West; the valley, farther S., being continued in a narrow valley, along its E. border, to Chickapee river.

The N. W. Trap Dike of the Eastern Primary, crosses the Mica Slate formation (3) very obliquely (N. N. E.) from a point not far S. of the N. line of the State, to another point S. W. of Monson village, and then traverses the present formation, in the same direction, at least to a point N. of Monson village, passing by the E. side of the granitic quarry N. W. of that village. The great S. E. Trap Dike crosses the most Southern point of the Granitic range (C 2,) N. N. E. to a point E. of Middle Haddam meeting-house, where, after entering the Micaceous range (C 3 ‡,) it bends abruptly East, and then crosses the S. part of the present formation (C 4,) to the Micaceous formation (D,) at East Hampton brook.

The four preceding formations form a group, arranged in parallel bands, the two widest of which consist of granitic or felspathic rocks, while between them is interposed a band, in which micaceous and quartzose rocks greatly predominate. This presents a striking illustration of the principle of compensation, by which the accumulation of one of the leading constituents of Primary rocks (felspar,) at one point, is balanced by a corresponding accumulation of the other leading constituents (quartz and mica,) at another. I have already observed that the Western range in this group (C 1) is continued from the Micaceous formation (B 3,) and that a connexion may be traced between the two central ranges (C 2—3,) and the ranges (B 2‡—4‡,) adjoining the Anthophyllitic formation (B 2) on the West and East, towards its Northern point, where they apparently communicate. The Eastern range (C 4) can be

more distinctly connected with the ranges (B 4—4 †,) extending along the Eastern border of the preceding group (B;) more especially with the range (B 4 †.) The present group might, therefore, be regarded as a continuation of the preceding group, Northward; but the Central Granitic formation (B 1,) in that group, resembles in the character of its rocks, the Eastern range (4) in the present group, while between them, the Southern termination of the two central ranges (C 2—3) is interposed. This might be regarded as a lateral shift to the East, in the series formed by (B 1) and (C 4,) between which the formations (C 2—3,) of similar extent with the more Northern member of that series (C 4,) are interposed, in nearly the same manner, as in the Western Primary, the Dover Limestone valley (L,) and the Mica Slate range (M,) are interposed between the N. point of the Highland range (K 3,) and the S. point of the Granitic range (K 1.) It has already been observed that the Sub-granitic range (B 4) apparently diminishes towards the North, as it approaches the Connecticut, while the Granitic range (B 4 †,) which farther S. is quite subordinate to the latter, expands in proportion, in the same direction. 'Opposite the point where this enlargement of (B 4 †) commences, the range (B 4 ‡,) West of (B 4,) apparently commences also, and farther N. expands into the two central formations of the present group (C 2—3.) The two formations (B 1—4) of the preceding group thus apparently run out towards the North, while the two central formations of the present group (C 2—3) commence between them, and the Eastern formation (C 4) also commences in the same parallel farther East, exhibiting an arrangement similar to the interlocking of different ranges along the transverse line crossing the middle part of the Western Primary.

D. *A Micaceous Ferruginous Formation* (Gneiss.)

This formation extends, in width, along the N. line of the State, from the preceding formation (C 4,) on the West, commencing on the East side of the valley, noticed under that

formation, to the West side of Muddy Pond (North Woodstock.) It continues of nearly the same width, as far South as the South part of Ashford, and the middle part of North Mansfield and North Coventry, where it suddenly contracts to a narrow band, on the West, running South along the Eastern border of the preceding formation (C 4,) through the East part of Bolton, and the West part of Hebron and Marlborough, to East Hampton. It there expands to a somewhat greater width, and again contracting still more, extends South, along the East side of Haddam Neck, West of the outlet of East Hampton Pond, and crossing the Connecticut, apparently runs out between (B 4 †,) on the West, and the succeeding formation (E 1,) on the East, at a point North of Chester brook. Some traces of it may be observed, however, farther South, along the West border of the formation (E 1,) as will be afterwards noticed. This formation extends North, into Massachusetts, of nearly the same width, as at the N. line of the State, at least through Wales, Holland and Sturbridge, and is probably continued as far N. as New Braintree and North Brookfield, or even still farther. From the preceding statement, it apparently commences on the S., in a long narrow process, like that at the S. point of the formation (E 1,) already noticed, but farther N., and suddenly expands, in the same manner as the latter formation, after which it extends Northerly, of nearly uniform width, as far as I have examined it.

Throughout the whole extent of this formation, a striking uniformity prevails in the general character of its rocks. Numerous varieties occur, but all peculiar to the formation, and grouped and alternating, in such a manner as to form a consistent whole. The most striking characteristic of this formation, is its peculiar ferruginous aspect. The soil is generally deeply red or yellow, particularly where formed more immediately from the decomposition of the rocks; the rocks are rusted on their surface, and occasionally decomposed to a considerable depth, into a red or yellow ochry earth, sometimes valuable as an iron ore; and deposits of bog ore occur fre-

quently in the swamps and valleys. This formation, in its ferruginous character, resembles the formation (I,) in the Western Primary; but, in the peculiar character of its rocks, more that section of the formation (H,) in the latter system, N. W. of Danbury (H 2 β.)

The predominant rock of this formation is a dark or light grey Micaceous Gneiss (α,) more or less pyritiferous and decomposable, whence the peculiar ferruginous character of the formation. The mica of this rock has generally a peculiar purple tint, noticed also in the micaceous gneiss of (H 2 β,) just referred to. Garnets are also generally found in the micaceous gneiss of this formation, as well as in the accompanying granitic gneiss and granite. This rock is usually rather coarse-grained, and more or less marked by parallel granitic seams or veins, occasionally contorted and interrupted. Beds or subordinate ranges, however, occur, of a fine-grained more uniform variety (β,) with a more decided purple tint to its mica. These beds are generally more ferruginous, and so decomposed and rusted near the surface, that the peculiar character of the rock can be observed only in the interior. Two leading sub-varieties may here be noticed; one of a darker tint (β 1,) usually harder and less decomposable, but with the surface generally coated with a dark brown rust, of no great thickness; the other (β 2,) of a lighter and more delicate purple tint, more or less filled with very thin seams or layers of a minutely fibrous white or light brown mineral (bucholzite ?) occasionally also disseminated through the mica. This latter rock is generally very decomposable, so that it often presents only an earthy, ferruginous mass to a considerable depth, strongly contrasting with the very delicate traits of its unaltered portion. Garnets often abound in this latter sub-variety, and occasionally it includes disseminated scales of plumbago. In some instances it is accompanied with thin bands of a compactly fine-grained black quartzy schist, usually abounding in pyrites, and also with minute scales of plumbago disseminated. Beds also occur of a very coarse-grained, dark grey,

thick bedded ferruginous variety (γ_1) abounding in parallel veins or patches of quartz, and not a little resembling the peculiar knotted rock of the formation (I,) in the Western Primary. The following varieties of gneiss, occurring in beds or subordinate ranges, may be also noticed in this formation; namely, a very light grey sub-granitic gneiss (δ_1) with a slight purple tint to its mica seams, rather coarse-grained, and more or less ferruginous and garnetiferous; a coarse-grained, dark micaceous gneiss (ε_1) more or less undulating in its structure, marked by smooth shining seams of black mica, with a peculiar soft talcy lustre, and accompanied with large garnets of a peculiar light purple variety; and another coarse-grained, dark grey, rather thick and even micaceous gneiss (ζ_1) occasionally forming subordinate ranges of considerable extent, one of which may apparently be traced from the Tolland and Willington road, in a line N. N. E. to the line of the State, near the N. E. corner of Stafford. The two latter varieties are very slightly ferruginous or decomposable. The former of these resembles not a little a peculiar micaceous rock accompanying the formation (F 2,) and a similar rock in the formation (E 4.)

Beds or subordinate ranges of a light grey Granitic Gneiss occasionally occur in this formation, particularly on its Southern and Eastern border, where they not unfrequently predominate. This rock varies from a bluish grey submicaceous variety, to a nearly white very felspathic variety, sometimes alternating in the same bed or range. The lighter varieties generally prevail towards the Eastern border, while in the interior of the formation the rock is usually less felspathic. The lighter varieties are usually, however, more or less clouded with minute disseminated mica, thus contrasting distinctly with the purer white Granitic Gneiss of the formation (E 1,) adjoining on the East. On the Western border of the formation, from the N. line of the State, at least as far South as East Hampton, a light grey sub-micaceous gneiss frequently is observed, characterized by its peculiar veined porphyritic or

sub-porphyritic structure, apparently allied in this respect to the sub-porphyritic Hornblende already noticed on the Eastern border of the preceding formation (C 4,) adjoining it on the West.* A similar, but less distinct porphyritic or sub-porphyritic structure may occasionally be observed in the granitic gneiss of the formation, particularly on its Eastern border. Interposed beds or veins of a white, very felspathic (albitic) Granite, are quite frequent in the present formation. These are usually small, but sometimes very large, and as is usually the case with interposed beds of granite, arranged in an interrupted series. The granite varies from coarse to fine-grained, and is usually, particularly the finer grained, distinctly parallel in its structure; differing in the latter case from the granitic gneiss, only by its more felspathic composition, and its more interrupted arrangement. Fine large purple garnets are found in this granite, particularly in a rather fine-grained, distinctly parallel variety, composed almost entirely of a pure white felspar.

Beds of Hornblende and Pyroxene are not unfrequent in this formation, particularly in certain subordinate ranges which they characterize. The Hornblende occurs more generally as a fine-grained, dark green, thin, even schist (α,) usually breaking in small jointed fragments, and is then usually accompanied by alternate beds of a similar fine-grained, but light green Pyroxenic schist (α,) both interposed in a dark thin micaceous ferruginous gneiss. The rocks in these Hornblendic and Pyroxenic ranges usually contain more or less of disseminated plumbago. Another variety of sub-hornblendic rock (β) occasionally occurs, particularly in connexion with a Plumbaginous range (‡,) to be afterwards noticed, extending N. N. E. through the N. W. corner of Ashford, and through

* A veined porphyritic structure may be distinctly traced in the rocks of the more Southern part of the present formation, even to its termination near the South line of Haddam, but the rock, marked by this structure, is there a coarse-grained micaceous gneiss, usually decomposable and ferruginous. The porphyritic rock, farther N., is generally very slightly ferruginous.

Union and Sturbridge. This variety is dark grey, with a coarse sub-porphyritic bluish felspathic ground, usually greenish from a ferruginous stain, with crystals of dark hornblende disseminated, and with small patches of a shining flaky black mica, transversely disposed in various directions, as if investing the crystals. It is also traversed by undulating parallel seams of a similar black mica, distinctly marking the stratified structure of the rock. It is thick bedded, breaking in large prismatic blocks, and is usually quite ferruginous and decomposable, disintegrating in small fragments, coated with the transverse patches of mica.

Plumbago may be considered as characteristic of the present formation. It occurs disseminated, generally in minute scales, and in seams or interposed beds or veins.* In the former state, it occurs frequently in the more ferruginous rocks of the formation, particularly in the micaceous rock (β 2,) which resembles not a little the micaceous ferruginous gneiss, with disseminated plumbago, in the formation (H W.,) N. W. of Danbury, and also in the hornblendic and pyroxenic ranges, above described, presenting there an association similar to that already noticed under the formations (K 1—2 W.) In the latter state, it is found apparently in large quantity, in the N. W. part of Ashford, adjoining the S. road from Stafford to Woodstock, and at the Black Lead Mine in the S. W. part of Sturbridge (Mass.) These two localities are apparently situated in the same range (†,) extending N. N. E. from the Ashford locality,

* In both conditions, it resembles mica very strikingly in its structure and arrangement. When collected in large masses, in beds or veins, it is sometimes finer grained and more flaky, with a parallel structure very similar to that of a micaceous schist, and like that usually undulating. At other times it is coarse-grained and plated, but still resembling the coarser grained micaceous schists, and is then often accompanied with small obliquely transverse granite veins, with disseminated points of plumbago, parallelly arranged, between which the plumbago retains its usual parallel structure, but much contorted, like the patches of dark green mica, in the granitic rock accompanying the formations (B 2—C 2 ^{2a}—C 3 †,) already noticed. The larger and purer masses generally present a uniform fine grain, like that of compact chlorite.

along a high ridge, passing through the centre of Union, which after being interrupted by the Mashapaug basin, near the N. line of the State, is again continued along the Western border of Sturbridge. This range is characterized throughout by the very ferruginous character of its micaceous gneiss, particularly in subordinate beds, abounding in disseminated plumbago, and also by frequent beds of hornblendic and pyroxenic schist (α,) and by occasional beds of the coarse sub-hornblendic rock (β.) These rocks accompany the Black Lead Mine, in Sturbridge, where there also occurs a peculiar thick bedded dark grey rock, very hard and compact, chiefly composed of a finer sub-porphyritic felspar, resembling that of the latter rock (β,) imbedded in a very fine black micaceous ground, with a peculiar silky lustre, particularly on its parallel seams, and accompanied with large porphyritic crystals of hornblende (hypersthene.) Large crystals of the same hornblende also occur in the coarser sub-hornblendic rock (β.) Plumbago has also been found, to some extent, in the valley of Fenton river, N. E. of North Mansfield, but apparently in a range farther E. than the preceding range. In a direction N. E. from this latter locality, on the E. side of Bigelow's river, on the Middle Boston Turnpike, is an extensive range of hornblendic and pyroxenic schist (α,) with disseminated plumbago, and similar ranges occur in a N. N. E. direction from this latter point, between Union and Woodstock, and between Sturbridge and Southbridge (Mass.)

The most important product of the present formation is its iron ores (Limonite.) Two varieties of this ore are now worked for the Stafford furnaces, namely, the common bog ore, deposited in low grounds by alluvial action, and a red or yellow ochry earth, formed from the decomposition of the more ferruginous rocks *in situ*. This latter, when well selected, is considered as furnishing the best material for the furnace, and is brought to Stafford from New Braintree and North Brookfield (Mass.,) as well as from localities at a less distance. A range, characterized by the frequent occurrence of such ochry beds, extends N. N. E. through the N. part of Willington, and along

the Eastern border of Stafford, and farther N. between Wales and Holland, in Massachusetts. In some places excavations have been made, in such beds of ochry earth, to the depth of several feet, exhibiting the structure of the rock unaltered, with occasional beds or veins of less decomposable rock, remaining unchanged, as has already been noticed in the Hematite beds of Salisbury. Occasionally layers or patches occur of an ore, nearly resembling a hematite, apparently formed from a portion of the rock, more highly pyritiferous, perhaps from small bands of a very dark fine-grained quartzose rock, quite filled with minutely disseminated pyrites, not unfrequently observed in connexion with the more ferruginous rocks of the formation, particularly the micaceous rock (β 2,) as already noticed. This latter rock generally prevails throughout the range, just described, accompanied with the other more ferruginous varieties, particularly (α) and (δ,) and alternating with bands of the less ferruginous, dark micaceous rock (ζ.) The more ferruginous rocks of the formation may be noticed in every stage of decomposition, exhibiting at first efflorescences of sulphur and of green and white copperas, and then diffusing a strong odour of the former mineral; afterwards passing into the earthy state, already noticed, or washed away to the lower grounds, where they furnish materials for a secondary formation of bog ore. This last is partly more solid and heavy, not a little resembling a hematite, but is more generally light and porous, and more or less accompanied with vegetable remains, forming a material quite inferior to the ferruginous earth above noticed. Bog ore has been worked, more or less, for the Stafford furnaces, in every town in this State, within the limits of the Northern main portion of the present formation, particularly in the E. part of Stafford and Tolland, and in Willington, Westford (Ashford,) Union and West Woodstock, and also in several towns in the adjoining part of Massachusetts. This formation retains its ferruginous character, in almost an equal degree, in the long narrow process terminating it towards the S. W.

The predominant rock in the latter part of the formation, is a coarse-grained dark micaceous garnetiferous gneiss, generally abounding in small parallel granitic veins or patches, with not unfrequent larger beds or veins of coarse white granite. Beds also occur of a finer grained more ferruginous micaceous gneiss, occasionally closely analogous to the fibrous seamed variety (β 2,) and like that, with disseminated plumbago. Seams of plumbago have been observed in this part of the formation, S.W. of Marlborough. The strata, in this part of the formation, and generally in its Northern main portion, range nearly N.N.E. and are usually nearly vertical (West.) Along its Southern border, as it expands towards the East, in Coventry, Mansfield and Ashford, they first apparently range Easterly, in an undulating course, and then bear N. East till they assume a N. N. E. direction in West Woodstock. In some places, on its S. border, particularly towards the West, in the vicinity of the Willimantic, the strata exhibit remarkable contortions, corresponding with the general undulating course of the Southern border of that part of the formation. This irregularity may perhaps arise from an abrupt change from the Easterly direction, near the Southern border, to the general N. N. E. direction, which the strata assume at no great distance towards the North.

Although the present formation exhibits no little variety in the character of its rocks, yet the different varieties are so arranged in alternate beds or ranges, as to present quite a uniformity of succession throughout the greater part of its extent. The most striking feature, in the formation, is the alternation of more ferruginous micaceous ranges (α—β—γ—δ) with others slightly so (ε—ζ.) Several alternate ranges, thus distinguished, might be traced in crossing the main body of the formation from East to West, some of them of considerable width. The more ferruginous ranges occur more or less frequently throughout the entire extent of the formation, and may be traced along the N. line of the State, from near its W. border in Stafford to the West side of Muddy Pond, in Woodstock. Ranges also occur, of greater or less extent, in different parts

of the formation, characterized by a greater prevalence of granitic rocks, particularly one, already noticed, apparently extending along the Eastern and a part of the Southern border. A more minute detail of the subordinate arrangement of this formation must be deferred to a more favorable opportunity.

The greater Eastern Trap Dike traverses the Southern point of the present formation, from near the junction of the E. and W. branches of East Hampton brook, N. Easterly, to a point not far S. W. of Marlborough meeting-house, and again enters the main portion of the formation E. of the Willimantic, a little N. of the Ashford Turnpike, whence it extends, in a general N. N. Easterly direction, through the centre of Willington, and the W. part of Union, into Holland (Mass.)

E.

Under this head, is included an extensive range, bearing N. Easterly, parallel to the Eastern border of the preceding formation (D,) nearly through the centre of the Eastern Primary, from the N. E. part of Chester, at least to Charlton (Mass.) The leading rock in this range, is a thin, rather light grey, generally fine-grained and uniform Micaceous Gneiss (1,) occupying the entire width of the range at its Northern and Southern extremities, and extending, throughout, along its Eastern and Western borders; inclosing detached subordinate formations of different character, between which it is also interposed. That part of the range occupied by this peculiar Micaceous Gneiss, might be regarded as constituting a distinct formation, and the included tracts be also treated as separate formations; but the entire arrangement can be more clearly presented by regarding the whole as a group, in which the included formations are subordinate to the more general Micaceous formation, inclosing them.

The present range, thus considered, commences towards the South, in a narrow process (‖,) already referred to in connexion with (B 4 †.) This consists chiefly of the fine-grained Micaceous Gneiss, already noticed, generally coarser

grained, as it approaches the adjoining formations, with occasionally a narrow lateral band, particularly on its Eastern border, of a coarse veined micaceous gneiss, with seams of fibrous bucholzite (?,) in which the Sillimanite, at Chester Cove, is also included. Traces of a similar kind may be observed as far S. W. as Westbrook village. A little N. W. of Chester village, the present range abruptly expands to the East, in the same manner as the preceding formation (D;) its Southern border bearing first nearly East, crossing the Connecticut just N. of Comstock's Ferry, and then passing S. of Hadlyme and Millington, when it bends round N. Easterly, through Salem (by the West side of Gardner's Pond,) and through the West part of Bozrah, and then more N. N. Easterly through the centre of Franklin and the Eastern part of Scotland (Windham,) through Hampton and Pomfret, rather East of their centres, and through the Eastern part of Woodstock and the N. W. corner of Thompson, into the Eastern part of Dudley, (Mass.) The present range adjoins, on the East, the range (*,) described in connexion with (B 4,) but properly an appendage of the Granitic formation (A,) nearly to its N. E. termination, in Salem; then the frontier felspathic range of (A,) to Gardner's Pond; and farther N. E. the next succeeding range (F,) to the most Northern point examined by me. It is immediately contiguous, on the West, throughout its whole extent, to the preceding formation (D,) and consequently its Western border first bears N. N. E., and then in an undulating course East, when it again bends round to the N. N. E., in a line nearly parallel to the Eastern border.

In the centre of this range, is included a series of subordinate formations, forming of themselves a range, conformable in direction to the general direction of the entire range. These are apparently divided into two sections by an interposed transverse band of the fine-grained Micaceous Gneiss (1,) passing through the South part of Exeter and through Goshen (Lebanon;) the Southern section (2) occupying the N. E. part of East Haddam, and the central part of Colchester; and the Northern

(3—4—5) extending from near the S. W. corner of Columbia, in a direction, first E. N. E. and then N. N. E., to a point not far S. W. of Muddy Brook village (Woodstock.) The characteristic rock of the Southern section (2) is a coarse ferruginous Micaceous Gneiss, very similar to that of the Southern termination of the preceding formation (in East Hampton.) The Northern section may be divided into three distinct subordinate sections, each of which might be regarded as a separate formation; namely, a Hornblendic-Chloritic formation (3,) extending in a narrow range along its Eastern border, not far West and North of Lebanon village; a wider range (4,) adjoining the latter on the N. W., characterized by alternate bands of a coarse dark Micaceous veined Gneiss, and a light grey Granitic Gneiss; and a range (5) of nearly equal extent, occupying the N. E. part of this section, composed almost entirely of a light grey sub-porphyritic Granitic Gneiss. Along the Eastern border of the present range, extends a long narrow formation of Mica Slate (6,) very similar, in form and character, to the Bolton Mica Slate range (C 3,) but passing towards the North, in Pomfret and Woodstock, into a peculiar subargillitic slate, sometimes even forming a well marked Argillite. This latter formation is separated from the range (F) next East, only by a very narrow band of the peculiar Micaceous Gneiss (1) of the present range. These subordinate formations, thus entirely inclosed in the Micaceous Gneiss (1,) might be compared to so many islands included in a lake. The series (2—3—4—5) may be also regarded as occupying the most central part of the Eastern Primary, intermediate between the Granitic range (C 4) on the West, and the extensive Granitic formation (A) on the East. The two more Northern of these (4—5) are comparatively more abundant in felspar than the including formation (1,) and the range (5) might even be regarded as strictly a Granitic formation, inclosed as a central nucleus.

1. *A Micaceous Formation* (Gneiss.)

This includes all that part of the present range occupied by the peculiar fine-grained Micaceous Gneiss, already referred to. It thus includes the narrow process (‖) at the Southern termination of the range, and the S. W. extremity of the main portion of the latter, S. W. of the included formation (2,) whence it extends N. Easterly, in two branches, an Eastern and a Western, along the corresponding borders of the range, apparently communicating, or nearly so, between the Northern and Southern sections of the included central formations, and finally uniting in one body occupying the whole width of the present range, at the North point of the included formation (5,) in North Woodstock.

The process (‖,) at the S. termination of the range, has already been described. At the S. W. angle of the main portion of the range, the present division occupies a rather narrow tract, W. of Connecticut river, in Chester and Haddam, whence it crosses to the S. W. part of East Haddam. The Western branch then extends N. N. E. in a band of moderate width, through the N. W. corner of the latter town and the S. E. corner of Chatham, and along the W. border of Colchester, into the S. E. part of Marlborough and the S. part of Hebron. Here it expands to the East, around the N. border of the included formation (2,) so as to communicate very nearly, if not entirely, with the E. branch, in Lebanon. In a section, from East to West, through Goshen, and the S. of Exeter and Hebron, the rocks throughout the whole interval between the Northern and Southern sections of the included formations, were distinctly connected with the present division, except a narrow band, between Lebanon and Goshen, apparently continued South from the Hornblendic formation (3,) as will be afterwards noticed. After the distinct commencement of the included range (4,) S. W. of Columbia, the Western branch again contracts nearly to its former width, and continues in the same N. N. E. direction, through Hebron and Gilead, into

the W. part of Andover, and the adjoining parts of Bolton and North Coventry. It then bends East, in an undulating course, between North and South Coventry, and North and South Mansfield, and again bears around from E. N. E. to N. N. E. through the South and East part of Ashford, and the middle of West Woodstock, till it meets the Eastern branch, as already explained. The Western branch, from the point where it bends East, is generally quite narrow, particularly towards the N. East. From the Ashford and Providence Turnpike nearly to West Woodstock, it is confined to a valley (that of the Nachaug,) extending along the West side of the high ridge occupied by the Granitic formation (5.) The Eastern branch extends East from Hadlyme, through the S. part of Millington, in a narrow band surrounding the included formation (2,) on the South, and then bends N. E. in a similar band through Salem, the S. E. angle of Colchester, and the West part of Bozrah and Franklin, into Lebanon. Here it expands considerably, East and South of the Hornblendic formation (3,) at the point where it apparently communicates, in the manner above noticed, with the Western branch, in Hebron. It again contracts at the passage of the Shetucket, between the East point of the same formation (3) and the bend in the Mica Slate range (6,) to be afterwards noticed, then expands anew between Windham and Scotland, and again contracting somewhat, extends N. N. Easterly in an undulating course through Hampton, Abington, Pomfret and South Woodstock, to its junction with the Western branch near Muddy Brook (North Woodstock.) North of that point, the entire range is occupied by the present division, forming a wide band extending more nearly North, between Dudley and Southbridge, into Charlton (Mass.)

Throughout the whole extent of the present division, from its most remote S. W. point to Charlton (Mass.,) it exhibits a remarkable uniformity of character, perhaps more so than any other Primary formation within the limits of the State. This is observable, not only in the character of its rocks, but in their arrangement, and in the form of the surface. The char-

acteristic rock of the present division is a thin, soft, very fine-grained and uniform, light dove grey Micaceous Schist, usually with a peculiar silky lustre, and a purplish tint, giving it the particular shade of colour above specified. Its weathered surface is usually much lighter, particularly in the Western branch, and towards the Northern extremity of the formation, giving it quite a distinctive aspect. This rock is generally more or less felspathic, and may be therefore called a Gneiss; but occasional beds occur, particularly in the Eastern branch, apparently composed of extremely fine-grained quartz and mica, from which the Quinabaug whetstones are obtained. A part of the Eastern branch of this division has been described as a Mica Slate, but the more general character of the rock hardly justifies such an appellation. This rock is very decomposable; usually so much so, that throughout a large part of its extent, particularly in the Eastern branch, it is almost entirely concealed by the earth formed from its decomposition, and its presence is only denoted by the profusion of its fragments in the soil, or occasionally revealed in ravines, or more rarely in abrupt declivities. It is usually somewhat ferruginous, but much less so than the more ferruginous rocks of the preceding formation. More usually it forms by its decomposition, a rather light grey sandy loam, which, particularly in the Eastern branch, as in Pomfret and Woodstock, furnishes a soil capable of great improvement.

In the Western branch, this rock is usually less fine-grained and uniform, with less of the peculiar tint, above noticed, and with more frequent small parallel and interrupted granitic veins, or veined porphyritic points of felspar. This veined character is more particularly observable near the borders of that branch, where the rock is still coarser-grained than in its interior, with darker mica, and at the same time more sub-porphyritic with felspar. It is there also usually less decomposable, with more frequently exposed ledges, and may be considered as approaching, in its character, the coarser Micaceous rocks of the adjoining formations (D) and (E 2—4.) In the more cen-

tral parts of the Western branch, subordinate bands occasionally occur of a coarse sub-porphyritic micaceous gneiss, often with garnets, and generally with alternate beds of a light grey sub-porphyritic granitic gneiss. These occur in that part of the range passing through Hebron and Andover, and one was observed on the West side of Mt. Hope river in Ashford. This latter band is separated from the preceding formation, on the North, by a band of the fine-grained micaceous gneiss of the present formation, with frequent interposed beds of Hornblende and Pyroxene. Generally throughout the Eastern branch, the rock presents its peculiar tint and lustre more strikingly than in the Western, and at the same time is finer grained and more uniform in its structure. These peculiarities may be distinctly traced from its S. W. extremity, North of Chester, to Woodstock. Beds of a peculiar variety of coarse flaky, very micaceous schist, generally nearly white, with a slight bluish tint, and highly pyritiferous and decomposable, may be traced at different points, from the S. W. part of the present division in East Haddam, through its Eastern branch, in Salem and Lebanon, at least as far as between Scotland and Windham. Generally it occurs near the middle line of that part of the present division, which it traverses, but in Lebanon it was observed more particularly near the Western border, not far from the line of junction of the Hornblendic formation (E 3.) This rock is generally known as the *sulphur rock*, from the decomposition of its pyrites. Farther North, in the S. E. corner of Ashford, a band of a darker silvery shaded coarse Micaceous Schist, also very pyritiferous and decomposable, extends along the Western border of the E. branch, adjoining the Granitic formation (E 5.) An excavation was recently made in this rock, known in the vicinity as the silver mine, but apparently presenting no other ore but iron pyrites. In the Northern part of the Eastern branch, in Abington and Pomfret, beds of a dark bluish Mica Slate occasionally occur, quite similar to the Mica Slate of the formation (E 6) on the Eastern border of the same part of the pres-

ent division. These are also quite ferruginous, but usually hard and little decomposable. They may perhaps be regarded as a continuation of the line of micaceous beds farther S. W., namely, those of the *sulphur rock*; the latter, towards the N. East, between Scotland and Windham, being accompanied with thin bands of a light blue Mica Slate, with parallel seams and patches of a coarser white mica, which last may be also traced more slightly in the localities farther N. East. In the Western branch, N. W. of Hebron, beds or subordinate ranges occur of a coarse very dark micaceous gneiss, with a peculiar talcy lustre to its plated mica seams, quite similar to the variety (ε,) in the preceding formation (D,) and like that usually undulating or contorted.

Generally the Micaceous Gneiss of the present division is more or less undulating, particularly where abounding in granitic beds or veins. Sometimes, however, it occurs very even, particularly in the finer more quartzose variety of the Eastern branch. The undulations, in the former case, are sometimes very large, forming an arch, extending along the entire front of ledges of more than thirty feet in length, and at other times are quite small, giving to the rock a peculiar uneven surface. The strata generally present only a small dip (to the West,) and occasionally, as at the S. W. extremity, adjoining the Connecticut, and in those parts of both branches where the direction is most nearly East, are nearly or quite horizontal, exhibiting by their undulation an apparent dip in almost every direction. From the slight dip to the West, the fronts of the ledges are generally presented to the East or South, but are rarely of much elevation. Large and small interposed beds of a coarse and fine white (albitic) Granite not unfrequently occur in the Micaceous Gneiss of the present division; not unlike that of the preceding formation, but harder and with a peculiar bluish tint to its felspar. Like the granite of that formation, it is very felspathic, and with an obviously parallel, often distinctly veined porphyritic structure. Blocks of this granite are not unfrequent on the surface, often appa-

rently in place, as if remaining after the decomposition of the rock inclosing them. Very large beds also occur, of a more or less fine-grained, light bluish grey Granitic Gneiss, often passing nearly to white, and then very purely felspathic; thus approaching the finer grained granite, just noticed. These are more particularly abundant in the S. W. part of the formation, adjoining the Connecticut; extending North into the Western branch, towards Hebron. This rock is sometimes quarried in the vicinity of the Connecticut, as at Chapman's Ferry, where it contains subordinate veins and patches of coarse granite and quartz. The granitic gneiss of this formation usually exhibits more or less of a porphyritic veined structure, resembling not a little that of the granitic gneiss accompanying the limestone ranges in the formation (H W.) The ground of the rock is generally finer grained and more uniform than that of the granitic gneiss of (D,) both in the light bluish and purer white varieties. The beds of granite and granitic gneiss apparently form detached masses or segregations, varying from comparatively small nodules, to beds of many rods in extent, and are generally of a flattened ovoid or lenticular figure. These are usually arranged in a series, forming as it were an extended interrupted vein, and are sometimes connected by narrow isthmuses, but more usually detached. The extremities of these isolated masses are often coarser grained, with veins or patches of quartz, and in the micaceous gneiss adjoining, patches of coarse crystalline black hornblende are frequent. The peculiar isolated arrangement of the granitic masses, in the present division, is best exhibited in the fronts of its ledges, where the strata are nearly horizontal. Striking instances of this kind occur in the S. W. part of the Eastern branch, E. of Hadlyme, particularly in a range of ledges on the West side of Whalebone Brook, on the road to Millington, and also in the vicinity of Coventry Pond, in the Western branch. In both these instances the direction of the formation is nearly East. The smaller masses are there frequently detached, by the decomposition of the including

rock, exhibiting their isolated arrangement with perfect distinctness. The beds of coarse granite, and of finer granitic gneiss, are apparently quite similar in structure and arrangement, differing only in grain and composition. The undulations in the strata of the micaceous gneiss are apparently caused by these included beds; at least this in many instances is clearly obvious. Smaller and more extended granite veins sometimes occur in the micaceous gneiss of the present division, which may be traced in a zigzag course, alternately interposed and crossing the strata.

In several points in both branches of the present division, from Woodstock to East Haddam, the Micaceous Gneiss is traversed by thin parallel and transverse seams of a black compact mineral, resembling jasper, so far as I have observed, entirely peculiar to the present formation. This occasionally occurs, in the vicinity of granitic beds, though not in immediate contact, but in other cases is observed quite remote from them. Beds of dark Hornblende are comparatively unfrequent in the present division. They are, however, less so in the Western branch, particularly along its Western border, adjoining the formation (D,) and in the vicinity of the bands of coarser micaceous gneiss with garnets, already noticed. Occasionally the coarser grained Micaceous Gneiss of the Western branch includes porphyritic points of hornblende, particularly adjoining its granitic veins and patches. Beds also occur there of a fine-grained darker grey variety, more or less sub-hornblendic, with parallel patches of coarsely crystalline black hornblende. Beds and seams of a light green, very fine-grained Pyroxene are much more frequent in the present division, particularly in its Eastern branch, and may be observed throughout its whole extent. These beds are usually quite thin, but are accompanied with a less decomposable greenish sub-pyroxenic gneiss, or with the ordinary grey micaceous gneiss, traversed by cross seams of light green pyroxene, adjoining which the rock is, for a short distance, less decomposable. On the Eastern border of the present formation, in the narrow band,

interposed between the Mica Slate range (E 6,) and the formation (F 1) next E., large beds occur of a light green fine-grained sub-pyroxenic gneiss, usually very decomposable, but with occasional layers of a harder more pyroxenic schist interposed. E. of the sub-argillitic band, in Woodstock, continued N. from the Mica Slate (E 6,) the micaceous gneiss, as it approaches the formation (F 1) next E., occasionally passes into a dark green chloritic schist, as will be afterwards noticed, in connexion with the two latter formations.

Along the Southern border of the Eastern branch, as it ranges Easterly from the Connecticut to Gardner's Pond, there apparently extends a band (†) of no great width, composed of a dark grey coarse micaceous veined gneiss, with subordinate beds of a white felspathic granitic gneiss, and of a peculiar light grey veined porphyritic gneiss. This may be regarded as a narrow process from the S. W. point of the range (F,) analogous to those at the S. W. extremities of the present and the preceding ranges (E—D.) The analogy of its rocks to those of the range (F) will be afterwards more particularly noticed. It is obviously connected with the coarse micaceous veined gneiss, with bucholzite, observed along the E. border of the process (‖) extended S. from the present range (E,) as well as with the porphyritic beds along the Western border of the range (B 4 *.)

The surface of the present division (E 1) generally presents a smooth undulating outline, with few exposed ledges, particularly in the N. part of the Eastern branch. In that part of the latter extending N. from Hampton, through Abington, Pomfret and Woodstock, it is characterized by a series of very smoothly rounded detached hills, in which the rock is usually entirely concealed. These form a striking contrast with the longer and more continuous ridges of the adjoining formations, and thus serve to mark the course of the present division.

The larger Eastern Trap Dike traverses the Western branch of this division in a N. E. direction, through Marlborough and Gilead to Andover, whence it bears more E. N. Easterly, be-

tween North and South Coventry, till it enters the formation (D,) E. of the Willimantic, in North Mansfield.

2. *A Micaceous Formation* (Gneiss.)

The Southern section of the central included formations of the present range (E,) may be regarded as a distinct formation of ferruginous Micaceous Gneiss, somewhat resembling, in its character, the formation (D.) This formation is apparently of a circular or oval form, occupying the N. E. part of East Haddam, the N. W. corner of Salem, and the greater part of Colchester, and extending into the S. W. part of Lebanon, S. of Goshen. Commencing at the S. W., the boundary of the present formation may be traced from the foot of the descent, W. of the town-house (East Haddam,) on the road to Moodus Landing, in a curve bearing E. around Millington village, at a distance of 1—2 miles on the S., whence it bears N. Easterly through the N. W. corner of Salem, and the S. E. corner of Colchester, to the Yantic, at the point where it bends E., near the Norwich and Colchester Turnpike. It then extends along the W. side of that stream to a point N. of that turnpike. The boundary on the W. extends N. N. E. from the point first mentioned, to the East side of the valley of Salmon river, West of Westchester village, whence it continues N. Easterly along the E. side of that stream, at least to the Hartford and New London Turnpike, N. W. of Colchester. In the latter part of its course it apparently sends two narrow processes Northerly into the preceding division (E 1,) E. and W. of Blackledge's Brook. These are perhaps connected with the bands of coarser Micaceous and Granitic Gneiss, already noticed, connected with the latter range in Hebron. I have already observed that the present formation is apparently separated from the Northern included section (E 3—4—5,) by an interposed transverse range of the micaceous gneiss of the preceding division (E 1.) On the Eastern border of this transverse range, W. of the valley of Pease's Brook, E. of Goshen, a narrow range of the peculiar Hornblendic rock of (E 3,) apparently extends in a line

N. N. E. from the N. E. point of the present formation, W. of the Yantic, to the S. W. point of the ridge occupied by (E 3,) N. of Lebanon. West of this, the E.—W. section, made through Goshen (centre,) exhibits only the peculiar rocks of the preceding division (E 1,) but near the middle point of this section, adjoining the line of Colchester and Lebanon, is a subordinate range of a fine grained micaceous gneiss, similar to that of the preceding division, but highly ferruginous, though less decomposable than the ferruginous rocks of the present formation. The country traversed by this E.—W. section is, however, generally covered with diluvium. Still the rock is exposed in a sufficient number of places to render the arrangement, above indicated, at least probable.

On the West, South and East, the present formation generally occupies a more elevated range, overlooking the lower country occupied by the preceding division (E 1,) which in those directions curves around it in an apparently even line. This range incloses, in its S. Western part, an extensive basin, in the N. part of East Haddam, partly occupied by Moodus Pond. S. of this basin, from the town-house (East Haddam) to Millington meeting-house, this range is peculiarly elevated, forming a conspicuous object when viewed from the higher summits, near the N. line of the State. It presents, on the S., a bold escarpment towards the valley along the N. border of the Granitic formation (A,) already noticed, descending by successive terraces, in the preceding division (E 1,) and the micaceous and porphyritic band, adjoining the latter on the South.

The prevailing rock in the present formation is a dark, silvery shaded coarse Micaceous veined Gneiss, usually more or less contorted, and with garnets disseminated. It is generally very ferruginous; often decomposing on the surface into a red or yellow ochry earth, usually observable in the excavations of roads, &c. within the limits of the formation. This is particularly the case in the N. E. part of the formation, in the vicinity of Colchester village. Deposits of bog ore are probably not

unfrequent in the low grounds, though little search has yet been made for them. An important bed of that ore has, however, been recently opened, in the valley of Cabin brook, W. of Colchester village. In the high ridge, between Colchester and Westchester, small beds occur of a very pyritiferous and ferruginous dark grey Quartz rock, rapidly decomposing when exposed to the atmosphere, with efflorescences of sulphur and copperas. A similar pyritiferous quartz rock has been already noticed under the formation (D.) In the same ridge subordinate beds occur of a dark grey fine-grained micaceous gneiss, somewhat resembling that of the preceding division, particularly the ferruginous variety, noticed in the transverse band, N. E. of Colchester. A subordinate range, of considerable width, apparently extends around, in the interior of the formation, in a line conformable to its exterior boundary, characterized by a darker grey, less coarse-grained, more even, and less ferruginous micaceous gneiss, accompanied with frequent beds of dark schistose Hornblende, and in some parts with extensive beds of a light grey even granitic gneiss. This is observed, towards the W., in the valley of Whalebone Brook, W. of Millington, and towards the E., in a ridge extending North from the Salem and Millington road, along the West side of Long Pond, and in the same line as far N. as the S. end of Colchester village. In that part of the range, West of Long Pond, the granitic gneiss predominates, but with frequent beds of Hornblende on its E. and W. borders. Exterior to this range, on the S. and E., is a range or series of large interposed beds of very coarse white Granite, accompanied with a very decomposable ferruginous micaceous gneiss, extending around, from the vicinity of the town-house (East Haddam,) S. of Millington, and thence continued N. Easterly parallel to the Eastern border of the formation, at least to the old road from Colchester to New London. In that part of the transverse band, above referred to, W. of the Hornblendic range along its Eastern border, in the vicinity of Goshen meeting-house, large beds of coarse and fine white granite and light grey granitic gneiss,

[illegible] of the preceding division (E 1,) form the pre- [illegible] on the surface, with occasional thin interposed [illegible] of the peculiar fine-grained micaceous gneiss of [illegible]. These Granitic beds are in the line of direction [illegible] of granite beds in the present formation, just al- [illegible] beds of coarse granite and of granitic gneiss occur, [illegible] repeatedly, in other parts of the present formation than [illegible].

5. A *Hornblendic and Chloritic Formation* (Sienite.)

The most important part of this formation occupies a narrow rocky ridge, composed of a series of detached summits, extending through the N. part of Lebanon, E. N. Easterly, from near the Columbia Turnpike, on the West, to the West bank of the Shetucket, at Spaffordsville (Windham,) on the East. Although the bearing of the entire range is E. N. E., the direction of the strata and individual elevations is more N. Easterly, in a line somewhat oblique to the range. This ridge, from its rocky character, presents a striking contrast with the smoother elevations of the adjoining formations, particularly with those of the Micaceous formation (E 1,) on the South, and from its elevation and detached position, forms a conspicuous object, when viewed in almost every direction, particularly from the North, East and South. Its higher summits overlook, in the latter direction, all the country as far as the high frontier ridge of the Granitic formation (A,) in Montville. Among the detached summits, in the line of the range, two are especially remarkable for their form and elevation, viz. Wunnegumaug (N. of Lebanon village,) near the middle of the range, and Obwebetuck, terminating the range on the East, in a bold promontory overhanging the Shetucket. A singular short summit of even greater elevation, presenting the appearance of a detached dike, rises on the N. side of the middle part of the range, within the limits of the present formation. From the Western termination of the ridge just described, the formation is apparently continued S. S. W., in a narrow band pass-

ing W. of Lebanon village, where it is concealed by diluvium, and farther South, along the W. side of the valley of Pease's Brook, E. of Goshen meeting-house, in a direction towards the N. E. point of the preceding formation (E 2.) In the latter locality, it presents a series of low ledges, near the foot of the declivity, West of the valley, and exhibits in its rocks the usual characters of the formation. In a direction nearly West from the main body of the formation (N. of Lebanon,) on the West side of the summit of the high ridge, N. of North Pond, and apparently near the S. W. point of the next succeeding formation (E 4,) a large accumulation of blocks and fragments occurred, resembling in character the rocks of the present formation, so extensively distributed, as to indicate the presence of a range of the same, at that point or in its vicinity. These fragments were, however, less hornblendic and chloritic than the proper rocks of the formation, and presented some analogy to the Epidotic Granitic Gneiss of (C 2 1 α.) They are more probably derived from a distinct range, subordinate to (E 4,) in a line farther West than the present formation. The main portion of this formation, occupying the ridge above described, extends along the S. border of the formation (E 4,) separating it from the Eastern branch of (E 1,) while the process, continued S. S. W., apparently forms a connecting link with the formation (E 2,) on the S. W.

The characteristic rock of the present formation, is a veined porphyritic or sub-porphyritic Hornblendic and Chloritic (Sienitic) Gneiss, usually distinctly stratified, or at least parallel in its structure. It varies in grain, from very coarse porphyritic, to very fine, nearly uniform; the former usually lighter, and more felspathic; the latter darker, and sometimes nearly black, like Hornblende rock. The darker part of the rock consists of a fine scaly, nearly black chlorite, with crystals of hornblende more or less disseminated. On the weathered surface, the chlorite and hornblende appear in relief, usually of a light green colour, particularly in the coarser, more porphyritic varieties. The porphyritic felspar of this rock is usually bluish

or purple. Occasional beds occur of a large porphyritic rock, resembling that of the formation (G S. 3 ζ W.,) West of Litchfield, characterized by specks of mica disseminated through its porphyritic felspar. The coarser grained varieties are usually thick bedded, and arranged in parallel beds, alternating more or less frequently with the finer grained, thinner and more schistose varieties. The latter sometimes pass into a thin, dark sub-micaceous schist. Occasional beds occur, particularly in the singular dike-like ridge, on the North, above noticed, of a very dark, thick, hard, prismatic, very hornblendic variety, remarkable for its weight, and usually rusting on its surface, like a trap. Parallel beds also occur, sometimes quite small, of a light silvery grey, or light greenish thin talcose schist, with layers of a very fine grained white or reddish felspar. These latter sometimes predominate, forming a granitic talcose seamed gneiss. Small beds are also observed, usually in connexion with the preceding, of a light grey, fine-grained granitic gneiss, with minute light green scales disseminated, somewhat resembling the granitic rock, accompanying the Chloritic range of (C 1.) These two latter varieties apparently are found only on the Eastern and Western borders of the formation. They occur in that position, on the S. side of the range N. E. of Lebanon, at the dike-like ridge just noticed, on the N. side of the same range, and in the narrow band West of Pease's Brook, towards the S. W. The fine-grained micaceous gneiss of the East branch of (E 1,) where it immediately approaches the present formation, N. E. of Lebanon village, is darker, harder, and less decomposable, and occasionally subhornblendic. The present formation, at its N. E. point, apparently bends to the South, the rock characterizing it appearing on the ascent of a lower ridge S. of Spaffordsville, but there more granitic, resembling the beds already noticed as occurring in other situations on the borders of the formation.

Taken in connexion with the range W. of Pease's Brook (S. W.,) this formation consists of a long narrow band, first extending N. N. E. and then abruptly bearing E. N. E. In

the latter part of its course, it forms the S. boundary of a series of parallel ranges, occupying the interval between it and the Southern border of the formation (D,) including the Western branch of the formation (E 1,) and the next succeeding formation (E 4,) all of which pursue the same E. N. E. direction to a point still farther East.

4. *A Micaceous and Granitic Formation* (Gneiss.)

Under this head, is embraced all that part of the Northern section of the included formations, not occupied by the Hornblendic formation (E 3,) and the Granitic formation (E 5.) It extends, apparently, from a point on the S. W., not far West of the S. W. corner of Columbia, E. N. Easterly through Columbia, South Coventry, the N. part of Lebanon and Windham, and South Mansfield, to Chaplin, whence it bears more N. Easterly, along both sides of the Nachaug, apparently terminating towards the North, near the Ashford and Providence Turnpike. This formation consists of a series of alternate ranges of dark Micaceous veined, and light grey Granitic Gneiss, or it might be regarded as composed of alternate beds of those two rocks, the one or the other predominating in different subordinate ranges. The examination I have made, does not enable me to determine the precise extent of these ranges, but although some of them may be traced to a considerable distance in the direction of the formation, yet none of them, apparently, are continued throughout its entire extent. Taken as a whole, the present might be considered as a Micaceous formation, in which are included detached subordinate ranges of a more granitic character.

The Micaceous Gneiss of this formation is generally coarse-grained, and sub-porphyritic veined in its structure, more or less contorted, and slightly fissile, and often with garnets disseminated. It very nearly resembles the prevailing micaceous rock of the Southern section (E 2,) but is usually but slightly ferruginous. At a point near the S. W. extremity of the formation, on the road from Hebron to Exeter, just W. of the sup-

posed sub-hornblendic range, noticed under the preceding formation (E 3,) is a narrow band of a very ferruginous, coarse micaceous veined gneiss, more nearly resembling that of the Southern section. In different parts of the formation, a coarse-grained undulating variety occurs, with seams of shining black mica, with a soft talcy lustre, resembling the variety (ε) in the formation (D,) and also the predominant rock in the Micaceous formation (F 2.) It is, however, much softer than the latter, as will be afterwards noticed. Beds occasionally occur, particularly in connexion with the latter variety, of a fine-grained, even, more fissile, dark micaceous gneiss, which, in some instances, might be usefully quarried for flagging. Large and small interposed veins and patches of coarse white granite, are not unfrequent in the micaceous gneiss of this formation. Traces of copper (yellow pyrites and green carbonate) are observed at different points in the micaceous gneiss of this formation, particularly in the vicinity of its granitic veins, and also included in the latter. Such traces occur at Chaplin and South Coventry villages, in Columbia, and East of Mount Hope river, in Mansfield. Beds of black and dark green schistose Hornblende are not unfrequent in the micaceous gneiss of this formation, particularly on its Northern border, and in certain subordinate bands, usually in the vicinity of the more granitic ranges. The preceding Hornblendic formation (E 3) might be regarded as a lateral appendage of this formation, on its Southern border.

The Granitic Gneiss of the present formation is usually light grey, rather coarse-grained, even or undulating, parallel dark mica seamed, and with more or less of a veined subporphyritic, or more rarely porphyritic structure. Alternate bands occur in connexion with it, of a darker grey, finer grained sub-micaceous variety, and occasionally of the coarse dark micaceous gneiss of the formation. Garnets are not unfrequent in the granitic gneiss, particularly the darker, finer grained varieties. Beds or ranges also occur of a more uniform white, and more rarely reddish felspathic variety, very

slightly mica-seamed, generally rather coarse-grained and thick bedded, with occasional alternations of the more common dark seamed sub-porphyritic variety. A range of this kind extends through South Mansfield, and thence along the Nachaug to the S. of Chaplin. Another range, of more interest, apparently extends from near the Columbia Turnpike, at Stone Hill, N. W. of Lebanon, in an undulating course, N. E. and E. N. E., to Willimantic village. The rock of this range is usually quite fissile, even or largely undulating; in its N. E. part, usually very light grey, white and more rarely red felspathic, slightly dark seamed, with occasional thin bands of the dark micaceous sub-talcose gneiss, above noticed, and of Hornblende. Interposed and cross veins of coarse white and reddish granite also occur. This rock is quarried extensively for building, at Willimantic village. At the Stone Hill quarry, in the South West part of the range, the rock is a very peculiar, thin, even or largely undulating, very fine-grained, white or red felspathic gneiss, alternating with thin layers or seams of a shining black micaceous gneiss, more or less accompanied with hornblende. Beds of a similar kind also occur in the Willimantic quarries.

A few details may now be given of the subordinate parts of the present formation, not, however, with the intention of exhibiting its exact arrangement. On its Southern border, adjoining the Hornblendic formation (E 3,) extends a range of light grey Granitic Gneiss, of the more usual character of the formation. North of this, occupying the high grounds at Village Street (Lebanon,) and extending to the Willimantic, below the village of that name, is a range of Micaceous Gneiss, partly the more usual coarse-grained variety with garnets, and partly, particularly near the Granitic range of Willimantic, the dark sub-talcose variety, above noticed. In nearly the same line Easterly, a woody ridge extends E. N. E. between the East branch of (E 1,) on the South, and the basin of Mt. Hope and Nachaug rivers (South Mansfield,) on the North, in which the prevailing rock is a coarse dark mica-

ceous veined gneiss, with garnets, more or less accompanied with beds of light grey granitic and sub-granitic gneiss, particularly on its S. border. Beds of the dark sub-talcose seamed variety also occur in the Micaceous Gneiss of this range. N. of the Micaceous range at Village Street, extends the Granitic range of Stone Hill and Willimantic, already described. The Granitic range of South Mansfield is in nearly the same line, but with an apparent lateral shift to the North. N. W. of the Stone Hill range, another of dark micaceous gneiss, abounding with Hornblende, and often sub-talcose, extends N. Easterly, along the W. side of Ten Mile river, at least to the Willimantic. N. W. of this, a range of the more common light grey Granitic Gneiss of the formation, extends N. Easterly through Columbia, apparently from the S. W. extremity of the formation to the valley of Hop river. A range of coarse dark Micaceous Gneiss, with Hornblende, particularly on its borders, extends from the N. side of the latter stream, through South Coventry village (where it exhibits traces of copper,) and is apparently continued along the N. border of the formation, into the S. E. corner of Ashford. After the formation bends more N. Easterly, near the passage of Mt. Hope river, it presents less obviously marked ranges, particularly towards its N. E. termination. It may be there characterized as a formation of coarse dark micaceous veined gneiss, with more or less frequent subordinate beds or ranges (of small extent,) of coarse white granite and of granitic gneiss, especially the former. The granitic gneiss is there generally coarser, more contorted, and more porphyritic veined than in the more S. W. parts of the formation. Beds or veins of coarse granite are there also more frequent, both in the micaceous and granitic gneiss. The Micaceous Gneiss, on the Western border, already alluded to, is separated from the range of similar Micaceous Gneiss, with copper, at Chaplin village, by a more distinct and extended range of Granitic Gneiss, extending N. E. from Mt. Hope river, at least to Stonehouse brook, N. W. of Chaplin. The direction of the subordinate ranges, as well as of the strata, is,

in the most S. W. part of the formation, N. Easterly; then Easterly, in an undulating direction; and from Mt. Hope river to the N. E. termination of the formation, from N. E. to N. N. E.

5. *A Granitic Formation* (Gneiss.)

This might be regarded as an appendange or subordinate range of the preceding formation (E 4,) but from its extent and well marked outline, is entitled to a separate consideration. It forms a band of moderate width, extending N. N. E. usually along a high tabular ridge, East of the valley of the Nachaug, between Chaplin and Hampton, Ashford and Pomfret, and West and East Woodstock. It commences on the South, near the N. line of Windham, at the East point of the woody ridge, South of the Mansfield basin, noticed under the preceding formation (E 4,) and terminates in a point S. W. of Village Corners (North Woodstock.) It is separated from the immediate valley of the Nachaug, by a narrow band of the preceding formation, to the Northern termination of the latter. Farther North it extends along the declivity, immediately East of that valley, and there adjoins the Western branch of (E 1.) Throughout the ridge, along which it extends, it separates the waters of the Nachaug, on the West, from those of the Quinabaug, and farther South, of the Shetucket, on the East.

The rock of this formation presents a great degree of uniformity throughout. It consists of a lighter or darker grey, coarser or finer grained, dark mica-seamed, white felspathic, veined sub-porphyritic Granitic Gneiss, generally quite even, and most nearly resembling that of the Granitic range along the South border of the preceding formation, adjoining the Hornblendic formation (E 3,) and that in the woody ridge N. E. of Windham. This rock is generally well adapted for quarrying, particularly the lighter grey and thicker bedded varieties. It is quarried to a considerable extent in the Eastford Woods, near the Providence Turnpike, and in the West part of Pomfret, farther N. E. Beds occasionally occur, par-

ticularly near its Southern termination, of a very light grey, more uniformly felspathic variety, becoming quite white on its weathered surface. Veins of coarse white granite occasionally, though rarely, occur, usually quite small, and in some instances alternately interposed and transverse. The same arrangement was observed in small granite veins, in the Western branch of (E 1,) particularly on the Nachaug, at the Eastford Factories. Micaceous and Hornblendic beds are very rare in the present formation. The band of coarse micaceous ferruginous schist, immediately adjoining the present formation, on its Eastern border, has already been noticed, in connexion with the Eastern branch of (E 1.)

In the line of direction of the present formation, North of its Northern termination, a range passes by Village Corners (North Woodstock,) nearly in the middle of the Northern part of the Micaceous formation (E 1,) after the junction of its Eastern and Western branches, consisting of a coarser grained, darker grey and less decomposable variety of the Micaceous Gneiss of the latter formation, with more or less frequent beds of a light bluish grey veined porphyritic Granitic Gneiss, and with large beds of coarse white Granite, apparently indicating the dispersion, as it were, of the present formation, in the Micaceous Gneiss of (E 1,) which there occupies the whole extent of the range (E.) This band extends at least as far North as the line of the State, and is throughout characterized by the rocky appearance of its surface, contrasting strongly with the smooth surface of the adjoining parts of (E 1,) where its rocks are more decomposable.

6. *A Mica Slate Formation.*

This forms a narrow range, extending N. N. E. along the Eastern border of the Eastern branch of (E 1.) It might even be considered a subordinate range of (E 1,) a narrow band of the peculiar micaceous gneiss of the latter apparently separating it from the formation (F 1) next East, and at the same time, beds of a Mica Slate, quite similar to that of the present

formation, occurring farther West in the micaceous gneiss of (E 1.) This formation apparently commences in the S. W. part of Bozrah, where traces of it may be observed North of Gardner's Pond. It first appears, however, distinctly on the Yantic, in a low narrow swell, about a mile E. of Bozrahville, whence it proceeds N. N. Easterly, through Franklin, by the meeting-house, there occupying a high ridge extending to the Shetucket, West of the entrance of Merrick's brook. In this part of its course, it apparently attains its greatest width, which, however, scarcely exceeds half a mile. N. of the Shetucket, it bends E. across Merrick's brook, and then resumes its N.N.E. course along the E. side of the valley of that stream, and farther N. along the summit of the high ridge between the latter and the valley of Little river, on the East. It then proceeds along the W. side of the latter stream to Hampton, whence it bears more N. Easterly through the S. E. part of Abington, to a point E. of Pomfret, and then again more Northerly along the Eastern border of Woodstock, and through the N. W. corner of Thompson, at New Boston, into Massachusetts. North of Hampton, this formation is of little width, rather forming a subordinate bed or range in the micaceous gneiss of (E 1,) and in some instances is apparently interrupted.

In the Southern and wider part of the formation (S. of Pomfret,) the predominant rock is a coarse plated, thinly schistose, more or less undulating, dark lead grey, very micaceous schist, with garnets and staurotides, quite similar to the more ordinary Mica Slate of the Bolton range (C 3,) with occasional beds of a coarser less fissile variety, knotted with small veins and patches of quartz, and with others of a finer grained, lighter grey, more even quartzose variety, sometimes with finely undulating plated seams of light blue mica. Occasionally the rock is very ferruginous, particularly in the vicinity of Hampton. Beds of a thick white Quartz rock, usually with a reddish or yellowish ferruginous stain, occur in the Mica Slate in Franklin. A range of large interposed beds of coarse white Granite extends along the Eastern border of the formation,

particularly along the West side of the valley of Little river, between Scotland and Hampton. From the N. E. part of Pomfret to the N. line of the State, the Mica Slate of this formation has a striking sub-argillitic character, more strongly marked towards the N. in Woodstock and Thompson, where it often exhibits beds or layers of as well characterized Argillite, as that of Woodbridge (B W.) Garnets are rare in this part of the formation. The Mica Slate there usually appears as a bed or narrow range subordinate to the micaceous gneiss of (E 1.)* This range of sub-argillitic Mica Slate is perhaps connected with the Argillitic formation, extending through Lancaster (Mass.,) in the line of direction of which it is apparently situated. The beds of fine-grained light green pyroxenic gneiss, in the narrow band of the micaceous gneiss of (E1,) extending along the Eastern border of the present formation, have already been noticed. The occasional chloritic character of the micaceous gneiss, East of the argillitic Mica Slate, in Woodstock, already referred to, is worthy of notice, as indicating a connexion between argillitic and chloritic rocks, such as occurs in (A—B,) and in (O,) in the Western Primary.

F.

Under this head, is included an extensive and well marked range or formation, extending N. N. E. along the Eastern border of the preceding range (E,) from Gardner's Pond, on the S. W., to the most Northern point examined by me. It includes all the remaining portion of the Eastern Primary, be-

* The Mica Slate of the present range, where it first assumes a sub-argillitic character, N. E. of Pomfret village, presents alternations of a less thin and fissile, very fine-grained, light bluish grey quartzose variety, with minute disseminated garnets, and of a very thin, finely undulating, light blue plated micaceous variety, approaching argillite. E. of North Woodstock, bands of a dark blue, more argillitic schist generally appear, alternating with others similar to the varieties just noticed. The more argillitic schist also presents alternations of a thinner, dark blue, plated and often finely undulating variety, closely resembling the more common Argillite of (B W.,) and of a lighter blue, thicker, hard quartzose variety, often very much contorted, and with thin seams of the former variety interposed.

tween the preceding range (E,) on the West, and the Granitic formation (A,) on the South and East. Its general direction is N. N. E. from its Southern border at Trading Cove, below Norwich, to a point between Webster and Oxford (Mass.,) where it bends Easterly, in an undulating course, through Sutton, conformably to the Northern frontier, at that point, of the formation (A.)

The present range offers a series of parallel subordinate ranges, of greater or less extent in the line of direction, which may be grouped, not inappropriately, under three leading divisions, arranged in a similar parallel order. These divisions, however, present in the character of their rocks, certain traits of resemblance, which entitle them to be regarded as a connected whole. The most Western of these divisions (1) extends, in a band of moderate width, along the Western side of the formation, throughout its whole length, so far as I have examined it, namely, from the N. end of Gardner's Pond, in Bozrah, to the W. side of the valley of French river, between Charlton and Oxford (Mass.) It is characterized by two varieties of Granitic Gneiss, which usually predominate, namely, a white felspathic and a grey sub-porphyritic variety, the last of which is accompanied, in its Northern part, by a peculiar large porphyritic gneiss. A white felspathic variety, similar to the first of these varieties, also occurs in more subordinate beds, in the division next East (2,) and a large porphyritic gneiss, very similar to that just referred to, on the Eastern border of the latter, already noticed in connexion with the Granitic formation (A.) This Western division might be conveniently termed the *Bozrah range*, from the town in which it first commences on the South. The division next East (2) is usually of greater width than the preceding, and may be regarded as the most important member of the present range. It commences on the S. W., at the head of a valley extending W. from Trading Cove, along the Northern frontier of (A.) Its strata apparently range Easterly along its Southern border, at least till some distance E. of the Thames, in Preston, but

are directed N. N. Easterly, at a short distance from that frontier, in a manner similar to the change in the direction of the strata, near the Southern border of the main portion of the formation (D.) This division then extends N. N. E. along the course of the Quinabaug, to North Killingly, where it makes a short flexure East, and then continues in its former direction, along the W. side of the valley of Five Mile river (Thompson,) and of the Great Pond (Webster,) to the point, where it bends Easterly through Sutton, as already noticed. This division is characterized by a peculiar dark Micaceous veined Gneiss, more or less accompanied with Hornblende, in beds or disseminated, and also with beds or subordinate ranges of light greenish grey Talco-Chloritic rocks. Throughout its entire extent, it immediately adjoins the preceding division on the West, and throughout the greater part of its extent, the formation (A) on the East. For some distance towards the S., however, the succeeding division (3) is interposed between it and the latter. The present division, in like manner as the preceding, might be called the *Norwich range*, from the town in which it first assumes its N. N. Easterly direction, and which is also included almost entirely within its limits. The remaining division (3) occupies the angle formed by the flexure of the formation (A) from E. to N, at Lantern Hill, extending N. along the Western border of the latter formation, to a point E. of Griswold, and S. of the Porphyritic section (A 3^{9} *b* 2.) This division is characterized by a peculiar Chloritic and Hornblendic Porphyritic rock, somewhat similar to that of the formation (E 3,) and alternating with other varieties of Chloritic and Hornblendic rocks. Chloritic-Hornblendic rocks, more or less nearly resembling those of the present division, occur at different points, along the Eastern border of the preceding division (2,) adjoining (A,) in Plainfield, Killingly, Thompson and Webster, but there generally in a situation quite subordinate.

The present range (F) may be considered as continued W., in the narrow band, already noticed, extending along the S.

Eastern border of (E 1.) The white granitic and porphyritic or sub-porphyritic rocks, accompanying that band, resemble the similar rocks of the Western division (1,) and the seams of bucholzite, observed in the same band, present an analogy to similar seams occurring in the second division (2,) to be hereafter noticed. The more hornblendic and epidotic rocks, accompanying the band (") extending along the N. border of (A,) from Chester to Salem, have a certain affinity to similar rocks accompanying the second division (2,) particularly in a subordinate range extending N. through its Eastern part, from Preston Northward. Not only is the entire formation continued, as it were, in a narrow process, to the S. W., in the band, just referred to, but the subordinate parts have a similar arrangement, relatively to each other. Thus the Norwich range (2) is continued W., along the N. side of the valley West of Trading Cove, nearly to Gardner's Pond, between the formation (A) and the S. E. point of the Bozrah range (1,) and a narrow band also occurs, on the N. side of that valley towards the East, composed of green Chloritic rocks, presenting some analogy to those of the third division (3,) there apparently continued W. between (A) and the Norwich range (2.)

The present range, as will be perceived by a reference to the map, has a very considerable width (about 12 miles,) at its Southern extremity, gradually contracting Northward, to a point at its bend Eastward in North Killingly, then expanding somewhat in Thompson, and again contracting apparently to its least width in Webster. In Oxford, as it bends East, it again expands apparently towards the N. W.

1. *A Granitic and Micaceous Formation* (Gneiss.)

This (the Western division, or *Bozrah range,*) first commences distinctly in the S. West part of Bozrah, at the North end of Gardner's Pond, whence it extends N. North Easterly, through the centre of that town and the East part of Franklin, through Hanover (Lisbon) and Westminster (Canterbury,) between Hampton and Brooklyn, through the East part of

Pomfret, along the Eastern border of Woodstock, and through the N. West corner of Thompson, East of New Boston, into Massachusetts. It is then continued Northerly along the West side of the valley of French river, between Dudley and Webster, and Charlton and Oxford.

This division, as has already been observed, is characterized by two peculiar varieties of Granitic Gneiss, a white felspathic and a grey sub-porphyritic variety. These are not arranged throughout in parallel uniform bands, but apparently in more or less detached subordinate ranges, the two varieties apparently alternating in their relative importance. Generally the sub-porphyritic variety predominates towards the Western border of the range, and the white felspathic variety, towards its Eastern border; but occasional exceptions occur, particularly in regard to the white felspathic variety. The sub-porphyritic ranges are generally much more uniform in their character, and very rarely accompanied with micaceous alternations. The white felspathic variety, on the contrary, is generally accompanied with more or less frequent micaceous alternations, and often appears only in subordinate beds in a rather light grey micaceous gneiss, and is then usually coarser grained, and accompanied with interposed beds of coarse white parallel granite. Generally along the immediate Eastern border of this division, extends a range in which the micaceous gneiss, just alluded to, predominates. This might, indeed, be regarded as an appendage of the second more micaceous division (2,) but its rocks rather resemble in character the micaceous alternations of the present division. Along the Eastern border of this range, beds of Hornblende are occasionally frequent, indicating a line of separation between distinct formations.

The Sub-porphyritic Gneiss (α) of the present division, is usually rather dark grey, from its disseminated black mica. Its grain is more or less undulating, with less uniform mica seams, than in the Granitic Gneiss of (E 5;) the mica being rather disseminated in detached flakes or patches, with a general parallel direction. The sub-porphyritic structure is also

more perfect, than in the rock of (E 5,) with occasional large distinct points of porphyritic felspar. The mica seams in the rock of (E 5,) exhibit more of the rounded sub-porphyritic structure of those in the granitic gneiss of (B 1,) while the grain is more parallel, and the porphyritic structure, when it occurs, more veined, than in the rock of the present division. Generally, this latter rock is coarse-grained, and rather thick-bedded, but bands occur of a still darker grey, finer grained, more micaceous, and more schistose variety, and others of a lighter grey, more felspathic, and more uniform variety; the latter, particularly, often well adapted for quarrying. The ranges of this sub-porphyritic rock are generally uniform in their character, alternations of micaceous gneiss, and beds or veins of coarse granite rarely occurring, and still less frequently beds of Hornblende. The white Felspathic Gneiss (β) of this division, particularly when it forms detached ranges, is usually rather fine-grained, uniform, highly felspathic, nearly even, with slight seams of white or light bluish grey mica. Its surface is usually a very pure white, but occasionally its felspar is reddish in the interior, perhaps from ferruginous stains. It is sometimes quite indurated, particularly at the S. West extremity of the formation in Bozrah, where it also contains small veins of coarse red granite, and seams of greenish mica. The Micaceous Gneiss (γ,) extending along the Eastern border of the formation, and also interposed in its more granitic portions, is usually coarse-grained, with more or less undulating, smooth plated seams of a light bluish silvery grey mica, with a soft talcy lustre, and is more or less porphyritic veined with a white (albitic) felspar. The granitic beds, subordinate to this rock, closely resemble the preceding rock (β,) but are usually coarser grained and less indurated. Parallel beds of coarse white granite are often quite frequent in this micaceous gneiss, not unfrequently distinctly isolated, as in the first division of the preceding range (E,) and accompanied with the same undulations in the strata of the micaceous rocks adjoining. Such

appearances are frequent on the Eastern border of the present division, near its Southern termination, West of Norwich.

The subordinate arrangement of the present division may be best exhibited by tracing it from South to North. At its Southern extremity, North of Gardner's Pond, the predominant rock is the white felspathic gneiss (β.) Farther North, in the centre of Bozrah, commences a more extensive range of the sub-porphyritic gneiss (α,) apparently extending North through Franklin to the Shetucket. This is bordered, on the Yantic, both East and West, by narrow bands of the white felspathic gneiss (β.) Along the Eastern border of the present division, thus far, extends a wide range of the micaceous veined gneiss (γ,) above noticed, with more or less frequent beds of coarse granite and of granitic gneiss, and on its Western border, occasionally accompanied with a dark grey, more sub-porphyritic variety of micaceous gneiss. This micaceous range apparently recedes from the Eastern border of the present division, towards the North, extending along the high ridge between the Shetucket and Little river, West of Hanover, where an apparently detached range of the white felspathic gneiss (β) is interposed between it and the second division (2,) East of Hanover. The sub-porphyritic range, above noticed, is apparently interrupted or greatly contracted, at the passage of the Shetucket, but it commences again, West of Little river, in the S. East corner of Windham, and crossing that stream, is continued N. along the Western border of the present division, in an apparently uninterrupted range, to the valley of the Mashamugit, in Pomfret. It extends, throughout this distance, from Little river Northward, along a slightly interrupted ridge, bordered on the East, by a nearly continuous valley. A range of the micaceous gneiss (γ,) with its usual granitic accompaniments, extends along the Eastern border of the present division, throughout this distance, and in some points, particularly between Hampton and Brooklyn, includes subordinate ranges of some extent of the white felspathic gneiss (β.) North of the Mashamugit, the present division makes a short bend East-

ward, S. of Pomfret village, which curve affects all the adjoining formations, from the Eastern branch of (E 1) to the Western border of (A,) inclusive. From this point Northward, the sub-porphyritic gneiss (α) is generally replaced by, or more or less extensively accompanied with a peculiar large Porphyritic Gneiss, already referred to. This rock consists of a dark grey, black or greenish, apparently sub-chloritic micaceous ground, with large porphyritic points of bluish or purple felspar. Usually it breaks in large prismatic blocks, and is rather soft and decomposable. It sometimes alternates with a thick bedded, dark micaceous, uniform fine-grained gneiss, occasionally subhornblendic. This porphyritic rock is particularly abundant on the Western border of the present division, East of Pomfret. East of Woodstock, this division extends along a remarkable ridge, called the Woods, and then crossing the Quinabaug, bends slightly N. East to the West side of the valley of French river, in the S. East corner of Dudley. In this part of its course, including the Woods, it presents a series of alternations of the porphyritic and white felspathic rocks, already described, the former predominating towards the West, and the latter towards the East. Near the North line of the State, the two rocks form apparently two distinct parallel ranges, West and East. The porphyritic rock is occasionally accompanied by a sub-porphyritic rock, similar to that farther South, and indeed small ranges of the same occur, particularly East of North Woodstock, near the passage of the Quinabaug. Along the immediate Western border of this division, East of the sub-argillitic schist, already noticed, in North Woodstock, the porphyritic rock has a dark green chloritic ground, with red porphyritic felspar, and is much indurated and very prismatic. The micaceous gneiss of (E 1,) adjoining, is also greenish chloritic, and similarly indurated. Along the Eastern border of the present division, from the Mashamugit, at least to the West bank of French river, near the line of Massachusetts, there generally extends a band of its peculiar micaceous veined gneiss, more or less accompanied with subordinate beds of

coarse white granite, and finer white granitic gneiss. Farther North this division consists chiefly of the white felspathic gneiss (β,) which extends North along the Eastern declivity of the ridge, West of the basin of French river, between Charlton and Oxford (Mass.)

The Granitic rocks of the present division, both the sub-porphyritic (α,) and the white felspathic (β,) are not unfrequently well suited for quarrying, and are already worked, to a considerable extent, at different points throughout its course. The sub-porphyritic gneiss (α) is quarried more particularly in the S. E. part of Franklin, South of Westminster, and East of Hampton, and the white felspathic gneiss (β,) in the subordinate range East of Hanover, and in that passing through the North West part of Thompson, in the vicinity of the Providence and Springfield Turnpike. The sub-porphyritic gneiss is usually softer and more easily worked, but at the same time more decomposable. The white felspathic gneiss often may be obtained in large even slabs, but is at times too much divided by jointed cleavages, particularly towards the S. W. extremity of the present division, as already noticed.

The arrangement of the present division very well illustrates the principle of compensation, already referred to. Thus in that part of it occupied by the sub-porphyritic gneiss, a great uniformity prevails, the materials being apparently equably distributed in the structure of the gneiss itself. In the remaining part of it, occupied by the micaceous and white granitic rocks of the division, a greater degree of segregation is observed; the mica and felspar being apparently collected at different points, more or less extensive.

2. *A Micaceous Formation* (Gneiss.)

This (the second division, or *Norwich range*,) is continued throughout the whole extent of the present leading range (F,) along the Eastern border of the preceding division (F 1,) being interposed between the latter, on the West, and the formation (A) and the third division (F 3,) on the East. It is

usually considerably wider than the preceding division, and might be regarded as forming the main body of the present leading range (F,) to which the other divisions are attached as appendages. It first distinctly commences, as already stated, at the head of the valley, West of Trading Cove, whence it extends at first in a direction rather South of East, in a narrow band along the South border of the East part of the preceding division. East of a valley, extending South from Norwich Town, at the New London road, its Western border bears N. N. Easterly, and continues in that general direction, in an undulating course, till it enters Massachusetts, on the East side of French river. Its Eastern border is continued Easterly along the N. border of (A,) South of Norwich and Preston, till it meets the W. border of the third division (F 3.) It then bears Northerly around that division, till it again meets the Western border of (A,) at the South point of the Porphyritic range (A 3 9 *b* 2,) whence it is continued along the same Western border of (A,) to the most N. Eastern point examined by me. The general direction of this division, like that of the entire range (F,) is N. N. E., (with a slight flexure East, in North Killingly,) till it makes its great bend to the East in Sutton (Mass.) Its strata generally conform in direction to that of the formation itself. Their peculiar arrangement at the Southern extremity of the present division has already been noticed.

The most characteristic and abundant rock of the present division, is a very peculiar dark grey, veined Micaceous Gneiss (α,) with smooth, more or less undulating parallel seams of a shining black, apparently sub-talcose mica. It is generally more or less pervaded by small parallel interrupted granitic veins, with occasional veined porphyritic nodules of bluish or purple felspar; the latter resembling those accompanying the sub-granitic gneiss of (B 4) and the coarser micaceous gneiss of (E 1.) It is usually quite hard, sometimes appearing as if indurated, and generally is much divided into rather irregular jointed blocks and fragments. Its ledges, from this

latter circumstance, and partly from its more or less ferruginous character, are generally much disintegrated, resembling trap ledges in this respect. Alternate beds of a fine-grained, thinner, more even, very dark, uniform micaceous gneiss, usually very hard, and breaking in small jointed fragments, occasionally are connected with this variety, particularly in the Eastern part of the formation. Interposed beds and veins of coarse white, and more rarely reddish granite, are not unfrequent, particularly in different subordinate ranges. One of these passes Northerly through the West part of Preston, from Poquetannock village to the Long Society meeting-house. In this, as well as in others, the beds are usually isolated, but arranged in a series, as has already been noticed in other formations. Magnetic iron occurs in detached nodules in the granite of this range, as well as of other ranges, and in a granitic bed, on the W. bank of the Thames, North of Trading Cove, a vein of the same ore of small extent has been recently discovered. Garnets are common in the micaceous gneiss, above noticed, and not unfrequently in a very dark, apparently more talcose variety, large purple garnets occur of peculiar beauty. In a similar variety, particularly in Preston, East of the range with granite, just noticed, small black or dark green chloritic nodules frequently occur, sometimes investing single garnets, or including a group of very minute garnets, but at other times apparently homogeneous. Seams of fibrous bucholzite are characteristic of the peculiar micaceous rock of the present division, particularly in its S. Western part, in Norwich. Fine specimens occur at Yantic Falls, and at the Rail Road Tunnel, near the junction of the Quinabaug and the Shetucket. The bucholzite and sillimanite occurring along the Eastern border of the S. W. extremity of the preceding range (E,) W. of the Connecticut, are here worthy of notice, as indicating a connexion between those remote localities and the present division, through the medium of the band (†,) extending along the South border of the same range (E,) as it bears Eastward through Millington and Salem.

The micaceous veined rock (α) of the present division very much resembles the undulating, apparently sub-talcose, dark micaceous veined gneiss of (D—ε) and (E 4,) already noticed, but is distinguished from them by its greater hardness.

The dark micaceous veined gneiss (α,) as already observed, occupies the greater portion of the present division. Other varieties of Micaceous Gneiss also occur, forming subordinate ranges of greater or less extent, in the general direction of the formation. A very dark micaceous, usually fine-grained and even gneiss (β,) with porphyritic hornblende more or less abundantly disseminated, and often accompanied with a fine-grained hornblendic or sub-hornblendic gneiss, with similar porphyritic hornblende, apparently forms an extensive range, extending through the Eastern part of the present division, from Preston to the most N. Eastern point examined by me. This rock is usually very prismatic, and not unfrequently abounds in seams and nodules of light green epidote. A light grey, or slightly greenish grey, usually very fine-grained, more or less talcose or chloritic gneiss (γ,) with very fine-grained white or reddish felspathic stripes, also apparently sub-talcose, occurs in several subordinate ranges, which may be traced throughout a considerable part of the present division, particularly adjoining the preceding sub-hornblendic range, on the East and West. This rock is quite distinct from the darker green, more chloritic rocks, along the Eastern border of the present formation. A light grey, usually fine-grained, very ferruginous (pyritiferous) micaceous gneiss (δ,) sometimes with a purple tint to its mica, and with fibrous seams (bucholzite ?) and somewhat resembling the more ferruginous micaceous gneiss of (D—β 2,) apparently extends, in a narrow range, throughout a great part of the present division, nearly in its centre; at least from Preston, East of the range with granite, above noticed, to the summit of the ridge, W. of the Great Pond, in Webster (Mass.) It apparently crosses the Quinabaug, from Preston, in its course Northward, and extends parallel to that stream, through the E. part of Lisbon and Can-

terbury, and farther N. passes distinctly between Thompson village and French river, to the point in Webster, above specified.

Hornblende rocks, under several different forms, are not unfrequent in the present division, but not so abundant as to be considered peculiarly characteristic. They occur both in subordinate beds, and in distinct ranges; the latter usually of no great extent. In the former state, they occur particularly in connexion with the dark micaceous veined gneiss (α,) and the dark sub-hornblendic gneiss (β,) of the present division. Two varieties may be noticed in this connexion, both uniform in their grain, very dark green or black, and composed almost entirely of hornblende; the one thick, hard, usually fine-grained and even, and breaking into small jointed fragments; the other thinly schistose, less hard and prismatic, usually fine-grained, when connected with the dark micaceous veined gneiss (α,) and particularly with its alternate beds of fine dark even micaceous gneiss, but not unfrequently more coarsely crystalline, when associated with the sub-hornblendic gneiss (β.) In this latter connexion, it is also more or less epidotic, like the rock it accompanies. A few subordinate ranges of Hornblendic rock may here be noticed. A range extends from the N. E. corner of Canterbury, near the West bank of the Quinabaug, N. N. E. through Brooklyn, East of the village, in which the predominant rock is a fine-grained, thinly schistose hornblendic, or dark micaceous sub-hornblendic gneiss, partly very even, and partly undulating or contorted. The more even varieties sometimes split in large thin slabs, very suitable for flagging. A rock of this kind is quarried to some extent in the N. E. part of Canterbury. The rock of this range, particularly, is often very epidotic, abounding in seams and layers of that mineral, and also in layers of a light greenish sub-epidotic granitic gneiss. On the West bank of the Quinabaug, at the passage of the Middle Killingly Turnpike, in the S. E. part of Pomfret, is a narrow range of a dark hornblendic, coarse or fine porphyritic or sub-porphyritic (Sienitic) rock, breaking into larger or smaller, usually rhom-

bic fragments. It is distinctly parallel in its structure, with a sub-chloritic hornblendic ground, and with porphyritic white felspar. The coarser grained is thick bedded, breaking in large blocks; the finer grained occasionally passes into a dark nearly uniform thin hornblendic schist. A series of Hornblendic and Chloritic rocks may be traced, at different points, along the Eastern border of the present division, more or less allied to the peculiar rocks of the remaining division (F 3.) These will be more appropriately considered in connexion with the latter division.

Beds and subordinate ranges of Granitic Gneiss occasionally occur in the present division. These are usually rather fine-grained and even; either white felspathic, like the granitic gneiss of the preceding division, or light bluish or greenish grey, and apparently sub-talcose or sub-chloritic. Extensive beds of the former variety occur on the E. side of the ridge through which the Tunnel passes, near the junction of the Shetucket and Quinabaug, and on the Eastern border of the present division, adjoining the succeeding Hornblendic division (F 3,) East of Preston City. A more extensive range, characterized more especially by frequent beds of the latter variety, extends along the E. side of the Quinabaug in the N. W. part of Killingly. The rock in this latter range is usually very even, and more or less prismatic, with epidotic seams. Occasionally beds of a pure white very felspathic variety occur in this latter range, which have been mistaken for limestone. The granitic gneiss there alternates with the light greenish grey sub-chloritic gneiss (γ,) with occasional beds of dark crystalline Hornblende.

On the Eastern border of the present division, near its Southern extremity, and adjoining the Hornblendic formation (F 3,) in a range of the dark micaceous veined gneiss (α,) a small interposed bed of white Limestone occurs, near the line of North Stonington and Preston. This is apparently interrupted, but may be observed, at least at two different points, in the same direction, at the distance of 1—2 miles. The lime-

stone is associated immediately with the fine-grained, thin dark micaceous gneiss, connected with (α,) and with a dark, fine-grained, schistose Hornblende. The strata are nearly vertical, which, as the bed is of little width, renders the working of it difficult. This is the only bed of limestone of any importance, observed in the whole extent of the Eastern Primary. Traces of copper are occasionally observed in the rocks of this division, particularly in the granite veins, as at the Rail Road Tunnel, already referred to, where the predominant rock is the dark micaceous veined gneiss (α.)

3. *A Hornblendic-Chloritic Formation* (Sienite.)

This division is chiefly composed of a circumscribed formation (α,) of moderate extent, consisting of a group of peculiar Hornblendic and Chloritic rocks, occupying the N. W. corner of North Stonington, and extending into the adjoining parts of Ledyard, Preston and Griswold. This formation is situated in the angle formed by the Western border of the Granitic formation (A,) as it bends from E. to N. N. E. at Lantern Hill. It is of an oval form, with its longest diameter from N. to S., extending 4—5 miles from a point S. of Griswold meeting-house, on the N. nearly to the North point of Lantern Hill, on the S. It presents a series of rounded detached summits, more elevated than those of the adjoining formations (A—F 2,) and thus forming conspicuous objects in the landscape. The highest of these, with Lantern Hill adjacent, are visible from the more elevated summits near the N. line of the State (in Westford and Woodstock.) These summits are arranged in two nearly semi-circular ridges, on the N. and S., inclosing a deep oval basin, on Broad Brook, E. of Preston, and separated from each other by transverse valleys on the E. and W. This formation is surrounded by distinct valleys, on every side but the North-Western, where it immediately approaches the preceding division (F 2.) These valleys are of moderate width, except on the S. W. and N. E., where they open into more extensive basins; that on the S. W. inclosed by the formations (A—F 2—

F 3,) and that on the N. E. extending N. along the Eastern border of (F 2,) through Griswold into Plainfield. This latter basin forms an important feature in the physical geography of the country, and may not inappropriately be termed the *Griswold basin*, from the town in which it is chiefly situated. The greater part of this basin forms an alluvial sandy plain, but ledges occasionally occur, particularly in the vicinity of the Pachaug, S. E. of Griswold meeting-house. These indicate the passage of a range of chloritic rocks (β,) Northward, along the Western border of (A,) appearing more distinctly on the Eastern border of the basin, on the road from Griswold to Voluntown, and continued at least as far N. as the S. point of the porphyritic range (A 3 9 *b* 2.) This latter range (β) is apparently connected immediately with the main formation (α.) Farther N., ranges of Chloritic and Hornblendic rocks, more or less allied to those of (α) and (β,) occur at different points, along the Eastern border of the preceding division (F 2,) East of Plainfield, at Westfield (Killingly,) on the E. side of the valley of Five Mile river (E. of Thompson,) and in Webster (Mass.) The relation of the narrow range of green chloritic gneiss, on the immediate S. border of (F 2,) in the valley W. of Trading Cove, to the present division, has been already noticed.

The most characteristic rock of the formation (α,) is a peculiar green Porphyritic rock (*Pseudo-Sienite*—Shepard,) not a little resembling the peculiar porphyritic rock of (E 3.) It consists of a rather light green chloritic ground, (with more or less of dark crystalline hornblende disseminated,) with large and small porphyritic points of a bluish or purple felspar. Sometimes the felspar predominates, when it is coarser grained and lighter; sometimes the chlorite and hornblende, when it is finer grained and darker. Its weathered surface is usually very light green. It occurs in thick interposed beds, alternating with more schistose varieties, and is itself distinctly parallel in its structure. It usually breaks readily in large or small jointed fragments. Similar thick beds of a finer grained,

coarse white granite, and finer white granitic gneiss. Farther North this division consists chiefly of the white felspathic gneiss (β,) which extends North along the Eastern declivity of the ridge, West of the basin of French river, between Charlton and Oxford (Mass.)

The Granitic rocks of the present division, both the sub-porphyritic (α,) and the white felspathic (β,) are not unfrequently well suited for quarrying, and are already worked, to a considerable extent, at different points throughout its course. The sub-porphyritic gneiss (α) is quarried more particularly in the S. E. part of Franklin, South of Westminster, and East of Hampton, and the white felspathic gneiss (β,) in the subordinate range East of Hanover, and in that passing through the North West part of Thompson, in the vicinity of the Providence and Springfield Turnpike. The sub-porphyritic gneiss is usually softer and more easily worked, but at the same time more decomposable. The white felspathic gneiss often may be obtained in large even slabs, but is at times too much divided by jointed cleavages, particularly towards the S. W. extremity of the present division, as already noticed.

The arrangement of the present division very well illustrates the principle of compensation, already referred to. Thus in that part of it occupied by the sub-porphyritic gneiss, a great uniformity prevails, the materials being apparently equably distributed in the structure of the gneiss itself. In the remaining part of it, occupied by the micaceous and white granitic rocks of the division, a greater degree of segregation is observed; the mica and felspar being apparently collected at different points, more or less extensive.

2. *A Micaceous Formation* (Gneiss.)

This (the second division, or *Norwich range*,) is continued throughout the whole extent of the present leading range (F,) along the Eastern border of the preceding division (F 1,) being interposed between the latter, on the West, and the formation (A) and the third division (F 3,) on the East. It is

usually considerably wider than the preceding division, and might be regarded as forming the main body of the present leading range (F,) to which the other divisions are attached as appendages. It first distinctly commences, as already stated, at the head of the valley, West of Trading Cove, whence it extends at first in a direction rather South of East, in a narrow band along the South border of the East part of the preceding division. East of a valley, extending South from Norwich Town, at the New London road, its Western border bears N. N. Easterly, and continues in that general direction, in an undulating course, till it enters Massachusetts, on the East side of French river. Its Eastern border is continued Easterly along the N. border of (A,) South of Norwich and Preston, till it meets the W. border of the third division (F3.) It then bears Northerly around that division, till it again meets the Western border of (A,) at the South point of the Porphyritic range (A 3 ^{9} *b* 2,) whence it is continued along the same Western border of (A,) to the most N. Eastern point examined by me. The general direction of this division, like that of the entire range (F,) is N. N. E., (with a slight flexure East, in North Killingly,) till it makes its great bend to the East in Sutton (Mass.) Its strata generally conform in direction to that of the formation itself. Their peculiar arrangement at the Southern extremity of the present division has already been noticed.

The most characteristic and abundant rock of the present division, is a very peculiar dark grey, veined Micaceous Gneiss (α,) with smooth, more or less undulating parallel seams of a shining black, apparently sub-talcose mica. It is generally more or less pervaded by small parallel interrupted granitic veins, with occasional veined porphyritic nodules of bluish or purple felspar; the latter resembling those accompanying the sub-granitic gneiss of (B 4) and the coarser micaceous gneiss of (E 1.) It is usually quite hard, sometimes appearing as if indurated, and generally is much divided into rather irregular jointed blocks and fragments. Its ledges, from this

usually breaking in small prismatic fragments, with alternate beds of a still more prismatic, fine-grained, slightly greenish, red felspathic rock, not unlike the frontier red felspathic rock of (A.) Epidote, in seams and patches, is abundant in these rocks. Beds of Hornblende, with seams and nodules of epidote, also occur in the same range.

At Westfield (Killingly,) blocks and fragments of similar Chloritic rocks are very frequent, apparently indicating the presence of a range of the same, in that vicinity. The immediate Eastern border of the present range (F) is, however, entirely concealed at that point by diluvium. The most frequent varieties occurring there are a dark or light green reddish porphyritic greenstone, a greenish quartzy chloritic schist, and a light grey prismatic Quartz rock; the latter perhaps transported from the Western Killingly Quartz range (A 3 9 Q 3,) though a similar grey Quartz rock accompanies the Chloritic range (β) East of Griswold, as already noticed. Traces of copper are observed there in the more chloritic fragments.

A range of Chloritic and Hornblendic rocks may be traced, at different points, on the Eastern border of the present range (F,) along the East side of the valley of Five Mile river, from near the South line of Thompson, to the North line of the State, S. East of the Great Pond (Webster.) The rocks in this range are chiefly a dark green Chloritic Schist, with alternate bands of a lighter green more quartzose variety, and a dark sub-porphyritic, usually very prismatic Hornblende. Thin bands or seams of a fine-grained red felspar occasionally occur in the chloritic rocks of this range, as already noticed in the N. Eastern part of (α.) The rocks, in this range, are frequently very much contorted. A narrow range of green Chloritic Slate, alternating with beds of a light grey or greenish Quartz rock, occurs on the East side of the outlet of the Great Pond, in Webster. The chloritic character of the porphyritic rock, on the Western border of the Granitic formation (A,) has already been referred to (A 3 9 *b*.)

A few remarks may here be offered in relation to the present

range (F,) considered as a whole. As in other instances, particularly that of (C 2,) it presents a series of more or less distinctly marked porphyritic rocks along its Eastern and Western borders, while in its interior such rocks are hardly observable. The porphyritic rocks of (F 3 α—β,) and the porphyritic ranges, described along the Western border of (A,) form the series along its Eastern border, and the sub-porphyritic rock (F 1 α,) and the larger porphyritic rocks connected with it towards the North, that along its Western border. The chloritic character of the rocks along its Eastern border generally, and of those along a part of its Western border, in Woodstock and Thompson, is also worthy of notice. This range presents several analogies to the formation (D,) in the character and arrangement of its rocks, and the two might indeed be considered as forming a whole, inclosing the range (E) on the East and West; the coarser grained rocks, partly with bucholzite, extending in a narrow band along the borders of the S. West extremity of the latter, apparently forming a connecting link between them. The formation (D,) like the present range, exhibits a series of rocks along its borders, with a more porphyritic structure than is found in the rocks of its interior. Both ranges present a line of more granitic rocks towards the interposed Micaceous range (E;) but their strongest relations are observed in the affinities of the dark micaceous veined rocks (D ε) and (F 2 α,) and of the very ferruginous micaceous rocks, with plumbago and seams of bucholzite, (D β 2) and (F 2 δ.) The resemblance of these is so obvious that it can hardly escape the attention of the casual observer.

General Remarks.

The details of the Eastern Primary System, and with it, of the whole Primary of the State, being now completed, a few leading remarks may be here introduced, applicable to the Eastern Primary, in particular, and to the whole Primary of the State, in general.

The two systems, Eastern and Western, from the preceding

details, appear to be entirely disconnected. The Eastern System presents, along its Western border, at least from the S. W. termination of (B 3,) Northward, a distinct frontier, conforming to the interior arrangement of the system. The green Chloritic rocks, along a part of this Western border, might perhaps be considered as connected with the Chloritic formation (A,) the most Eastern, in its position, in the Western Primary; but they are in general so different in structure from the rocks of that formation, and at the same time so analogous, in that respect, to the Micaceous rocks of (B 3,) as to render such an opinion, at least, but little probable.* The arrangement of the formations, on the Eastern border of the Western Primary, apparently indicates a general direction of the same to the North, instead of a strong flexure to the East, which would be necessary to bring the formation (A W.) into connexion with the Western border of the Eastern Primary, at the point where the Chloritic rocks, above noticed, are first distinctly observable, namely, in the vicinity of Bluff Head, between Durham and North Guilford (B 3.)

The most striking feature, presented by the Eastern Primary, is the extensive range of Granitic Gneiss (A,) on its Southern and Eastern border, apparently enveloping the remaining formations, in that direction. The Western border of this range presents, as has already been observed, a series of flexures, all of which, within the limits of the State, may be considered as forming one extensive curve, with its convexity to the East, as in the general curve of the Western Primary, but with apparently a stronger curvature than in the latter, giving its radius a direction more to the North. The direction of the Western border of (A) is first Easterly, along the coast, West of the Connecticut, and then West of North, along the course of that river, to Chester.† The curve, thus formed, embraces

* The probabilities of this opinion, derived from the resemblances of some of the chloritic rocks along this Western border, to certain rocks of (A W.,) have been already given (p. 221.)

† The range (B 4*) is here considered as connected with (A.)

the group of formations (B,) on the South and S. East. The Western border of (A) then bears E. N. Easterly to Gardner's Pond, and then nearly East to Lantern Hill, where it bends abruptly N. N. East, and continues in that direction to Webster (Mass.) The extensive curve, thus formed, embraces the two ranges (E—F,) on the South and East; the former immediately adjoining it to Gardner's Pond, and the latter throughout the remaining distance. The flexure to the East, in Sutton (Mass.,) may be here incidentally noticed.

If we view the Eastern Primary in the Northern part of the State, we find it presenting a series of parallel ranges, corresponding to those in the Western Primary. These ranges, proceeding from West to East, consist of the four parallel ranges, included in the group (C,) the formation (D,) the two ranges (E) and (F,) and the formation (A,) the Eastern border of which last is beyond the limits of my exploration. The group (C) might be regarded as one entire range, continued from the group (B,) in much the same manner as (H) and (I,) and (F) and (G,) in the Western Primary, are combined so as to form continuous ranges. The subordinate parts of those two groups apparently interlock with each other, at their line of junction, in a manner similar to the arrangement at the line of junction of (H—I W.) This subject has already been explained in treating of those groups in particular. The ranges between (C) and (A) present, at their S. West extremity, an arrangement, to which there are but few analogies in the Western Primary. I allude to their termination, in that direction, in long narrow processes, gradually running out between the adjoining formations, extended farther South. Thus (D) apparently runs out, in that manner, between (C 4,) continued S. in (B 4 †,) and (E ;) (E,) between (B 4 †) and (*,) appended to (A ;) and (F) may be traced S. Westerly in the narrow band, interposed between (E,) on one side, and (A) and its appendage (*,) on the other. The cases most analogous, in the Western Primary, are found in the long narrow Micaceous range (β,) connected with (F 4—5,) in Wilton and Reading, ap-

parently continued S. S. West from the Mica Slate formation (G S. 3,) and the Micaceous range (H 2 δ^2,) also apparently continued S. S. West, from the S. West point of (I.) These, however, are separated from the formations from which they are apparently continued, by other interposed ranges; the Micaceous range (β,) from (G S. 3,) by the Newtown Porphyritic range (F 6 β,) and the range (H 2 δ^2,) from (I,) by the Kent Limestone valley (H 2 ϵ,) while the processes terminating (D—E—F,) in the Eastern Primary, are continuous with the main body of those ranges.

The more extended ranges, above noticed, present a general conformity, among themselves, in direction and flexure. Their general direction is North-Easterly, in an undulating course, more strongly marked in the more Eastern ranges; more directly North, and less undulating, in the more Western. In comparing the flexures of these ranges, the following analogies may be observed. The flexure, on the Western border of (A,) from E. N. E. to East, between Gardner's Pond and Lantern Hill, corresponds to the Easterly bend, in the included formations (3—4) in the range (E,) distinctly marked by the course of (E 3,) North of Lebanon village. This flexure is still more strongly marked in the Western branch of (E 1,) as it bends East, through Coventry and Mansfield, and in the adjoining Southern border of the main portion of (D.) A corresponding slighter flexure may be observed in the ranges (C 3—4,) between Tolland and Vernon, affecting in an equal degree the Western border (D,) but apparently not extending to the two more Western ranges (C 1—2.) It is, however, opposite the line of separation of the Northern and Southern sections of (C 2.) The same flexure may be traced in the Eastern branch of (E 1,) and in its included Mica Slate range (E 6,) more slightly however than in (E 3—4,) in the bend East, at the passage of the Shetucket. This affects, in nearly an equal degree, the Western border of (F 1.) The Easterly direction, observable at the S. West extremity of (F 2,) corresponds to this flexure.

It has been already remarked that the Western border of (A) makes a slight bend East, along the course of Five Mile river (North Killingly.) This flexure affects in a nearly equal degree the Eastern and Western divisions of (F,) and the Eastern branch of (E 1,) particularly the included Mica Slate range (E 6.) It is less distinctly traceable in either of the ranges farther West, but may be apparently observed in some degree as far West as the Eastern border of (D) in West Woodstock, in a direction towards the N. West. The Easterly bend in Sutton (Mass.,) I have traced distinctly only to the adjoining formation (F 2.) Some appearances, between Oxford and Charlton, apparently indicate that it extends also to the formations (F 1) and (E 1,) farther West. If it affects at all the more Western formations, it is probably quite in the Northern part of Massachusetts.

The flexures, in the Eastern Primary, apparently have no relation to those in the Western, but like those of the latter, are most strongly marked in the more central part of the system, and gradually diminish in extent towards the Western border. The principal flexure in the Western System, that marked by the Easterly bend of (E,) at Beacon Mountain, diminishes towards the East, so as to be but slightly apparent in (A,) and in like manner, the principal flexure in the Eastern Primary, that marked by the Easterly bend of the Western branch of (E 1,) becomes scarcely apparent in the two most Western ranges of that system (C 1—2.) The flexures of the Eastern System are all situated in a line farther East than the most Eastern in the Western System, namely, that just alluded to. This last, if continued in its transverse S. E. direction, would meet the Eastern Primary S. W. of the South Western termination of (B 3,) and consequently farther West than the first great flexure of the Western border of (A,) namely, that embracing the group (B,) on the South. It is worthy of remark, that the ranges in the Western Primary, not interrupted by the Secondary, bend to the North, from the East point of the flexure, above noticed, and even bear round towards the

West, as if receding from the Eastern System, while the ranges on the Western border of the latter pursue a N. N. Easterly course, conformably to the general bearing of that system. But although the flexures of the two systems are thus independent of each other, yet their general arrangement is very similar; presenting a series of undulations in a general North-East direction, alternately more Easterly and more Northerly.

Traces of a concentric or inclusive arrangement are more strongly marked in the Eastern than in the Western System. These have been already noticed, in the separate formations, in which they occur, particularly in (B) and (E.) In the group (B,) the Granitic formation (B 1) apparently forms a central nucleus, nearly or entirely surrounded by the Anthophyllitic range (B 2,) and partly by other sections of the same group (B 2‡—B 4.) In the range (E,) the fine-grained micaceous gneiss (E 1) incloses a series of central included formations, nearly separated by the same into two distinct sections, (E 2) and (E 3—4—5.) Of these, the Southern section is distinctly micaceous; the Northern, not including its lateral Hornblendic range (E 3,) partly micaceous and partly granitic. The Mica Slate range (E 6) is also apparently included in the micaceous gneiss (E 1.) In the Western Primary, the formations or ranges, inclosed in more extended formations, are generally granitic, as in the case of the isolated Granitic ranges in the N. part of the Mica Slate formation (G.) In both the Western and Eastern Primary, circumscribed formations occur, interposed between two contiguous formations, sometimes apparently forming an interrupted series in the same general line of direction. The isolated Porphyritic ranges along the Western border of (F) and (G,) in the former, and the Hornblendic-Chloritic formation (F 3 α—β,) with the apparently isolated Chloritic ranges, on the Eastern border of (F 2,) farther N., in the latter, may be quoted as examples of such arrangement. The remarks in relation to the more or less circumscribed outline of the different formations and subordinate ranges in the Western Primary,

are equally applicable to the arrangement of the Eastern Primary. This may be observed very distinctly in the S. W. termination of the more extended ranges (D—E—F,) and in the included formations of the range (E,) and also very generally in the interior arrangement of the subordinate parts of the larger formations. It has already been referred to more particularly in the arrangement of (A 3,) of the groups (B) and (C,) and of the Western division of the range (F.)

In the general remarks on the Western Primary, I have noticed a change in the character of the formations, along a transverse line, crossing that system in a S. Easterly direction, nearly in the line of the Housatonic, in its S. Easterly course from Kent to Derby, or tracing it by the Southern border of (I) and (G,) forming an irregular curve, with its convexity to the South. A similar arrangement may be noticed in the Eastern Primary, marked by the Southern termination of (C 2—3,) particularly by the abrupt Southern termination of the proper Mica Slate range of (C 3,) at Great Hill, by the Southern termination of the main body of (E) and of its included formations (E 2) and (E 6,) and farther E. by the Southern termination of (F 1—2—3.) This line also forms a curve distinctly convex to the South, and is not only marked by a change in the character of the formations, but a distinct depression of the surface may be observed throughout a considerable part of its extent. The N. point of the group (B,) marked by the curve of the Anthophyllitic range, at the passage of the Connecticut below Middle Haddam, and by the N. point of (B 3,) also indicates the direction of this transverse line. The Western termination of this line is nearly opposite the Eastern termination of that in the Western Primary, as marked by the line separating (F) and (G,) in that system. The Connecticut crosses the different ranges at the junction of the groups (B) and (C,) from the Secondary to the Western border of (E,) in nearly the same manner that the Housatonic follows the general course of the transverse line in the Western Primary. This transverse line corresponds, however, strictly to that in the Western Primary,

only in the interval between the groups (B) and (C.) Farther E. it corresponds with the Northern frontier of the Granitic formation (A,) in its Easterly course from the Connecticut to Lantern Hill. The formations there, on the opposite sides of this line, are not arranged in the same line of direction, mutually interrupting each other, as is the case in the groups (B—C,) and in (F—G) and (H—I,) in the Western Primary; but the general bearing of (A) is there Easterly, while the formations N. of the line are abruptly deflected West, at their Southern extremity, terminating in the narrow processes already described.

One remark may here be made, applicable both to the Eastern and Western Systems, namely, the general Western direction of the strata and formations, along the coast, at least as far W. as the Western part of Fairfield, and even traceable, though less distinctly, quite to the Western line of the State. This apparently indicates that the present line of the coast has been determined by the original formation of the rocks, and not by any posterior or accidental subsidence, and that it corresponds with the original line of elevation of the great Primary region, extending along the Atlantic coast of North America.

Besides the distinctions already noticed, between the Eastern and Western Primary Systems, I will here just hint at one derived from the physical character of their rocks. Not only have the different rocks of each local formation a common generic character, but this community of character may be extended to larger groups, and even so far as to embrace the two great systems, just alluded to. At present I will only remark that the peculiar structure most distinctly observable in the mica seams of the granitic gneiss of (B 1,) which might be termed *round sub-porphyritic*, may be considered as forming the distinctive character of the rocks of the Eastern Primary, in nearly all of which it is in some degree obvious.

A few remarks may be here introduced, generally applicable to the Primary rocks of the State. My observations have sat-

isfied me that there is a structure peculiar to these rocks, and which may be traced more or less distinctly through the entire series, from the coarsest granites to the finest and most uniform schists. This structure is characterized by a parallel arrangement, often very distinct even in the coarsest interposed granites. This parallel arrangement is always more or less disturbed, as if by a force acting transversely; the different individuals of the mass, or its segregations, being usually placed more or less oblique to the direct line of the stratification. This oblique direction is continually changing from right to left, not in a manner indicating a mere undulation in a fluid or cohesive mass, but from an apparent change in the axes of the crystals. This structure is, I conceive, the result of crystallization, and not of any mechanical action.—There is also a continual tendency to a segregation of the constituent minerals of these rocks. Rarely, if ever, are these uniformly distributed, individual by individual, but are usually collected in detached masses of greater or less extent, arranged more or less distinctly in conformity with the parallel structure of the rock. They thus represent, even in the finer grained rocks, more or less extended, but interrupted, parallel veins, or porphyritic points, analogous to those in the porphyritic rocks, so called, or even, on a small scale, the large detached interposed beds of coarse granite, so common in the Primary of the State. Like the latter, too, they are generally arranged in a series, in a direction usually more or less oblique to the stratification. Frequently in the more schistose and finer grained rocks, these segregations assume the form and direction of more or less nearly transverse veins, which at one or both of their extremities often take a more parallel direction. Generally in such cases the intimate structure of these segregations is in the general line of the stratification, and consequently transverse to the direction of the segregation itself. These phenomena apparently furnish a clue to the formation of larger transverse veins, as of granite and quartz, the more applicable as these transverse veins not un-

frequently exhibit a structure, parallel to the line of stratification, and transverse to that of the veins, passing distinctly into the structure of the adjoining schistose rock, as if both were formed simultaneously, by the same process of crystallization, and without any seam or appearance of alteration in the adjoining rock, as in the case of trap dikes. Even in transverse veins of massive crystalline quartz, particularly in those accompanying the Granitic formation (A,) especially the more granitic rock (A 3 a_1) crystals of felspar are often included, precisely similar to that of the adjoining rock, and arranged in the parallel direction of the latter.—This tendency to segregation is also no less observable in the arrangement of formations and of their subordinate parts, indicating a general law, extending from the largest to the smallest operations in the formation of these rocks. This has already been sufficiently pointed out in the details given in the preceding pages. We there observe a continual alternating series of granitic, micaceous, hornblendic, and various other formations, and in the same formation a similar alternation of beds of like character. The observations I have made have led me to consider these as in some measure controlled by a law of *compensation*, applicable at least to the three leading constituents of Primary rocks, quartz, felspar and mica, by which, when one of these is accumulated or segregated, at a given point, the others will be found, in like manner, accumulated in the vicinity. This is well illustrated by the micaceous and quartzose ranges accompanying the Granitic formation (A E.) adjoining which the granitic rock is usually more peculiarly felspathic. The Western division of (F E.) also illustrates this principle in the arrangement of its subordinate parts; the three constituents being more equably disseminated in the sub-porphyritic range (a_1) and more segregated in the white felspathic and micaceous ranges (β—γ.) Generally where a formation is more entirely micaceous, with less extensive granitic segregations, the latter appear in beds or veins of coarse granite, while in the more extended granitic formations, the rock assumes the character of a finer grained granitic gneiss.

The Trap Rocks.

It has already been stated, in the introduction to this report, that the Trap rocks of the State are partly connected with the Secondary and partly with the Primary rocks, but that in both they present appearances of a common arrangement. The Trap rocks, connected with the Secondary and Primary of the State, resemble each other so nearly too in physical character, as to render it highly probable that they are of the same origin. It has also been stated in the introduction, that the Secondary rocks have been apparently controlled in their arrangement by the Trap rocks accompanying them, thus indicating a cotemporary formation. No such conformity is observable between the Primary rocks and their accompanying Trap rocks; the latter crossing the different Primary formations indiscriminately, and conforming only to the system of arrangement peculiar to the Trap rocks in general; thus indicating an origin posterior to that of the Primary. This connexion, in character and arrangement, between the Trap rocks, both of the Secondary and Primary, has induced me to class them under the same general head. The system of arrangement, in the Secondary rocks, is at the same time so subordinate to that of the Trap rocks accompanying them, as to render it proper, in my view, to defer their consideration till after the latter have been described.

The Trap rocks in the State, as already noticed in the introduction, form a series of dikes and ridges, traversing two Secondary formations, of very unequal extent, and also four extensive dikes, traversing the Primary rocks, two in the Eastern, and two in the Western System. The Trap in each of the Secondary formations, presents a peculiar system of arrangement, complete in itself, but in both apparently regulated by the same general principles. The dikes, traversing the Primary, are apparently appendages of the Trap system, connected with the larger Secondary formation.

In describing the Trap of the State, a few remarks may be

first offered on the general principles of arrangement, common to the Trap of both the Secondary formations. The Trap rocks, in both these formations, appear either in the form of more or less extended mountain ridges, or of well characterized dikes; the latter generally of comparatively small extent. The former present, as a general rule, an abrupt declivity to the West, and usually appear, in that direction, as masses overlying the Sandstone. Very frequently, however, they are overlaid by the Sandstone on their Eastern, more gradual declivity; thus apparently forming interstratified masses or inclined dikes. In some instances, where the middle portion of a ridge appears thus interposed, or merely as an overlying mass, its extremities appear as distinct vertical dikes. In some instances, too, the dike-like character of extensive ridges is quite evident, even in their middle portions; and in other instances, one part of a ridge appears obviously as an overlying or interposed mass, while another part is as distinctly a vertical dike. The range formed by East Rock and Mill Rock (New Haven,) presents a striking example of this latter arrangement. The ridge and the dike may thus be regarded only as modifications of the same arrangement.

The different ridges and dikes, as already observed, present in each Secondary formation a system of curvilinear ranges, in a general N. N. E. direction, (corresponding to the direction of the stratification, in the Sandstone, as well as to the general direction of the Primary,) and with their convexity towards the West. These more extended curvilinear ranges are themselves made up of a series of subordinate curves, more or less detached, and the latter occasionally present curves of a still inferior order, which last are composed of a series of elevations more or less distinct; in the higher ridges, apparent only on their summits; in the lower ridges, sometimes detached to their base. These single elevations (hummocks) have generally more or less of a curvilinear outline, conformable to that of the more extended ranges. This tendency to a curvilinear arrangement is less striking in the

dikes, than in the inclined ridges, but is usually there sufficiently obvious. The dikes, both in connexion with the Primary and the Secondary, rarely form a continuous unbroken ridge of any great extent, but are subject to frequent interruptions, by cross valleys and lateral shifts of greater or less extent, and in these interruptions the including rock (Primary or Secondary) is often interposed. This almost constant series of lateral shifts gives to the dikes a curvilinear outline, in some instances as strongly marked as in the ranges above referred to.

In tracing any one of the subordinate curves, forming the more extended ranges, the single elevations (hummocks) will be found arranged in a certain order of succession, varying in different parts of its course, in such manner as to produce the curve. These elevations rarely, if ever, succeed each other in the same direct line, but with a lateral shift, of greater or less extent, and it is by the degree and direction of this lateral shift, that the different orders of succession are determined. These may be reduced to three general divisions, namely, the *Advancing*, the *Receding*, and the *Continued*. In the first, the hummocks, as they succeed each other, overlap the preceding in front, more or less considerably, and by the degree in which this takes place, as well as by the extent of the lateral shift, the ridge is made to advance, more or less, in the direction of its convexity. In the second, the reverse takes place; the succeeding hummock falling behind the preceding, and thus causing the ridge to recede in the direction of its concavity. In the continued order, the hummocks follow each other in nearly the same line of direction, but in perhaps every instance, with a slight lateral shift, generally varying frequently from an advancing to a receding order, and thus giving the ridge more or less of a serpentine form in that part of its course. The continued order may thus be regarded as a modification of the two preceding, but of a character sufficiently distinct to be considered separately. The advancing and receding orders are both necessary to the formation of a

curve; the former, at its commencement; the latter, at its termination. The degree of curvature will depend upon the degree of advance and recession, at the two extremities. More generally, however, the middle portion of the curve is arranged in the continued order, with a well marked advance and recession only at the extremities. In such cases, the degree of curvature is usually small. The subordinate curves, composing the more extended ranges, also succeed each other, in a manner similar to that already stated. Generally, the advancing order is most strongly marked, at the commencement of the main curve, formed by them, and the receding order, at its termination; while in its middle portion, the subordinate curves are arranged more nearly in the continued order. Usually these subordinate curves are separated by cross valleys, of greater or less depth, which in the advancing and receding order of succession, cross the main range very obliquely, but in the continued order, are more directly transverse. In the latter instance, too, they are generally of less depth; sometimes merely forming a depression on the summit of the range. When a curve is arranged in its middle part, in the continued order, with a strong advance and recession at its extremities, it has no longer the form of a regular curve, but presents a combination of three curvilinear lines, usually separated from each other by distinct interruptions. This is usually most strongly marked in the main curves, which in some instances present, at their extremities, particularly that towards the North, after an abrupt recession, as above explained, an extended subordinate range in the continued order. This will be more obvious, when we come to a more detailed account of the different ranges.

The larger Secondary formation is generally considered as extending from New Haven Harbour, on the S., to the North part of Northfield (Mass.,) on the N. From the observations I have made, I have been led to regard it, considered in this extent, as composed of two subordinate formations, nearly or quite separated by a range of Primary rocks, extending across

the valley of the Connecticut, through Hatfield, and the North part of Hadley and Amherst (Mass.) The Northern of these is comparatively of small extent, including in its centre a group of elevations, the highest and most extensive of which are composed of Sandstone, with only one curvilinear range of Trap, occupying the most central portion of the formation, and generally of much less elevation and extent, than the accompanying ridges of Sandstone. The Southern of these formations occupies much the greater portion of the entire basin, and includes a more extensive series of Trap ranges, which present much the most elevated ridges in the formation, and also some of the highest summits in the Southern part of New England. The Trap in the Northern subordinate basin is thus much less extensively and strikingly developed than in the Southern, while the elevations of its Sandstone are of relatively greater importance.

The Trap in the Southern subordinate formation presents two distinct lines of elevation, an Eastern and a Western. The first of these is the most extensive, and traverses more nearly the centre of the formation. It presents a series of four main curves, gradually increasing in elevation and extent from South to North. The most Southern and smallest of these curves extends along the W. side of Saltonstall's Pond (East Haven,) and is from that circumstance called the Pond Ridge. It forms a very strongly marked curve, extending from the immediate frontier of the Eastern Primary, S. E. of the outlet of the pond, above mentioned, to within a short distance of the same frontier at the ponds, S. W. of North Branford village. The chord of its curve extends nearly N. East, a distance of 4—5 miles. The second main curve commences at North Branford village, less than a mile N. E. of the N. E. point of the preceding, and also forms a very complete curve, extending in an unbroken ridge, called Toket (Tetoket) Mountain, to the immediate border of the Eastern Primary, at Bluff Head, about half way between North Guilford and Durham. The chord of this curve also extends nearly N. East, a distance of 7—8

miles. This curve thus exceeds the other in extent, and is also more elevated, particularly towards the N. E. These two curves succeed each other nearly in the continued order, the N. E. termination of the former fronting the S. W. termination of the latter, with a wide valley opening transversely between them. The third main curve is still more extended, and more elevated than the latter. It commences in advance of the second main curve, at the mountain rising between Paug Pond and the valley of the Middletown Turnpike, N. E. of Northford. It extends at first nearly North, in continued order, forming the high mountain ridge E. of Wallingford and Meriden, then advances abruptly to the ridge of Lamentation Mountain, and again extends N. N. E. in a line E. of Worthington village (Berlin,) to the Mattabesick, where it bends rather abruptly E., in receding order, and continues in the same general direction, to near the W. bank of the Connecticut, not far N. of the S. line of Wethersfield. From the N. point of Lamentation Mountain, this curve recedes from the main Eastern line of elevation, and presents only a series of ledges, of less height even than the two preceding curves. The chord of this curve ranges more N. N. Easterly, and extends at least 17—18 miles. The fourth, and most Northern of these curves, is also the most elevated and most extensive. It commences on the S. at the Hanging Hills, in strong advancing order, in a line nearly W. of the South point of Lamentation Mountain, from which last ridge the main line of elevation is continued. It forms, at its Southern extremity, a short but very strongly marked curve, fronting the South, and bending quite abruptly North, extends, at first, nearly North, in slightly advancing order, to Farmington (Rattlesnake) Mountain, whence it bears more N. N. Easterly, in continued order, to the Connecticut, at the N. point of Mount Tom. It there recedes abruptly to the East, in the same manner as the preceding curve, at the passage of the Mattabesick, and is then continued nearly East, in the ridge of Mount Holyoke, to within a short distance of the Western border of the Eastern Primary. This range pre-

sents at its S. W. and N. W. points, the two most elevated summits connected with the larger Secondary formation, namely, the Hanging Hills and Mount Tom. The chord of its curve extends N. N. Easterly, like that of the preceding, a distance of nearly 60 miles. These four main curves, as they proceed North, thus progressively increase in extent, not in an exactly regular proportion, but sufficiently so to indicate a systematic order, in that respect. The two Southern curves meet at their points; the two Northern being each in advance of that immediately preceding, the Northern point of the latter passes behind the succeeding curve, to a certain distance, which also increases towards the North.

The main curves above indicated, are accompanied with parallel subordinate ranges, both anterior (on the West,) and posterior (on the East,) which conform more or less exactly to the curvature of the main range. The number and proportionate extent of these lateral ranges is greatest in the most Southern and smallest curve, and least in the largest and most Northern, except at the Southern extremity of the latter, where the posterior ranges are unusually developed. The development of the lateral ranges is thus, in general, the reverse of that of the main range. By a reference to the map accompanying this report, it will be seen that the most Southern main curve, with its anterior lateral ranges, projects considerably to the West of the line of the second and third main curves, but less than the Northern main curve. If a line were drawn from the N. W. point of the most anterior range of the Southern main curve, to the S. W. point of the Northern main curve (at the Hanging Hills,) it would pass by the N. E. point of Mount Carmel, the N. E. point also of the first main curve in the Western line of elevation. If the Southern and Northern main curves were thus united by a continued range, the Eastern line of elevation would form but a single curve, with its chord in a direction more nearly N. than that of the Northern main curve.

The Western line of elevation, in the Southern subordinate

formation, presents an arrangement the reverse of the Eastern. It consists of two subordinate lines of elevation, separated by a wide interval of Sandstone, opposite the Southern most developed portion of the Northern main curve in the Eastern line of elevation. The Southern subordinate line presents two main curves, of which the Southern is the most extensive. This commences in East Rock (New Haven,) nearly opposite the middle point of the most anterior range of the Southern main curve (Eastern line.) The general direction of the curve is, at first, nearly W. to West Rock, when it bends abruptly N., forming a long continued ridge, with an obvious curvature, and again bears rather abruptly E. N. E. to the elevated summit of Mount Carmel, beyond which it is continued at a lower elevation to the W. bank of Wallingford river. This range, where it assumes a more E.—W. direction, both at its Northern and Southern extremities, is much more interrupted than in its middle portion, where its direction is more nearly N.—S. The Northern, less extensive main curve, is not so inferior to the preceding, in length, as in general magnitude. It commences in immediate connexion with the preceding, at the point where that bends E. to Mount Carmel, and at first advances abruptly West, crossing the N. point of the Argillite formation (B W.,) and then extends N., apparently along the Eastern border of the Mica Slate formation (C W.,) and of the Porphyritic formation (D W.) It then bears more N. Easterly, receding from the Primary, and at last terminates in a low ridge, in the plain, in the S. part of Southington, nearly West of the S. W. point of the Hanging Hills (N. curve—E. line.) The Northern subordinate line of elevation commences, on the S., near West Avon meeting-house, nearly opposite the middle point of Talcott Mountain, one of the most considerable summits in the Northern main curve (Eastern line,) and extends nearly N. along the immediate border of the Western Primary, to the N. W. corner of Simsbury, when it bends rather abruptly Eastward, to two singular elevations, called the Barn Door Hills, in the S. of Granby. It there again assumes a Northern

direction, at first very slightly elevated, and terminates in Manituck Mountain, a detached ridge nearly in the middle of the plain occupying the Secondary, West of the Eastern line of elevation. This Northern line of elevation thus presents two sections, or main curves; the Southern, well marked at its Northern termination; the Northern, with very slight curvature, and appearing rather as an anterior lateral range, subordinate to the Eastern line of elevation. The Southern is also more important both in extent and general magnitude. This Northern subordinate line of elevation is considerably less extensive than the Southern line, already noticed. The Western line of elevation is thus most developed in its Southern section, and in the Southern portion of each of its sections respectively, while the Eastern line of elevation presents a gradual increase in extent and magnitude, in its progress towards the North.

The Western line is much less provided with lateral ranges, than the Eastern, and only with posterior ranges; the anterior being precluded by the near approach of the main line of elevation to the Western Primary. The Southern curve of the Southern subordinate line, presents only a few small dikes, as its posterior ranges, and all of these but one, very near the main line of elevation. Two ranges, of more considerable extent, are situated posterior to the Northern curve of the same subordinate line, one of which conforms to that curve, in its direction, while the other appears, by its direction, rather as an anterior range to the N. East part of the Southern curve (viz. Mt. Carmel.) This arrangement will be afterwards more particularly explained. The Northern subordinate line of elevation presents no appearance of lateral ranges, so far as my observations have extended.

The Western line of elevation might be considered as subordinate to the Eastern, or at least, as complementary of it, being more largely developed, where the latter is less so, and the reverse. Thus its Southern, most extensive curve is opposite the least extended portion of the Eastern line, and the remarkable summit of Mt. Carmel, near its N. East termina-

tion, is opposite the recess, in the Eastern line, between the first and fourth (Northern and Southern) main curves, already referred to. The Western line of elevation is interrupted, opposite the Southern most largely developed portion of the Northern curve (Eastern line,) and again appears, in its Northern section, opposite one of the least elevated portions of the same curve, namely, that between the North point of Talcott Mt. and the South point of Newgate Mt. Although the Western line of elevation is thus, in some degree, subordinate to the Eastern, yet it does not conform to it, in its arrangement, like the lateral ranges accompanying the latter, but presents a system of arrangement peculiar to itself.

The Trap accompanying the smaller Secondary formation, like that accompanying the Northern Section of the larger formation, forms only one central curvilinear range. But, unlike the latter, it predominates over the Sandstone of the formation, in a still greater degree, than the Trap accompanying the Southern Section of the larger formation. All the most considerable elevations of the formation are occupied by the Trap; the Sandstone appearing only as a lateral accompaniment. The curve of this range is very well marked, particularly at its Southern termination, and presents three subordinate portions, arranged in receding order, towards the North.

The dikes accompanying the Primary, it has been already observed, are apparently appendages of the Trap System, connected with the larger Secondary formation. This is not only indicated by the general resemblance of the Trap of these dikes, in its physical characters, to that accompanying the Secondary, but still more by the conformity of these dikes, in their arrangement, to that of the system above mentioned. These dikes are four in number; two connected with the Western, and two with the Eastern Primary. They might be considered as forming two pairs, complementary of each other, in the two Primary Systems respectively; the North-Western dikes, in the two systems, corresponding, and also the South-Eastern. The extent of the corresponding dikes,

at least so far as they appear within the limits of the State, is reversed in the two Primary Systems; the N. Western dike being the most extensive in the Western Primary, and the S. Eastern, the least extensive, while the reverse is the case in the Eastern Primary. The two corresponding dikes are not continued in the same direct line, on opposite sides of the Secondary formation, but each Eastern dike is situated in a line farther East than the corresponding Western dike. Thus the S. termination of the larger Eastern dike, is nearly E. S. E. from the N. E. termination of the smaller Western dike, while the smaller Eastern dike, corresponding to the larger Western dike, commences on the opposite side of the Secondary, at a point nearly E. N. E. of the Northern termination of the latter, instead of N. N. E., the direction of the latter, at its Northern termination. These dikes, both in the Eastern and Western Primary, approach at one of their extremities, the border of the Secondary formation, and recede from it at the other. Their general direction is thus N. Easterly, corresponding to the general direction of the Primary, as well as to that of the chords of the different main curves of the Trap, accompanying the Secondary. The two Western dikes terminate on the N. East, nearly opposite the Southern point of two of the main curves of the Secondary Trap System; namely, the S. Eastern, opposite the S. point of the most Southern curve of the Western line of elevation (at West Rock;) and the N. Western, opposite the S. point of the Northern main curve of the Eastern line of elevation (at the Hanging Hills.) The S. Eastern dike approaches the immediate border of the Secondary, about a mile N. W. of West Rock, and opposite its termination, in the direction of the dike, at that point, a spur projects from the West side of the West Rock range, apparently indicating the passage of the dike into the latter. This will be hereafter more particularly noticed. The S. W. termination of the larger Eastern Trap dike corresponds to the Southern termination of the Southern curve of the Eastern line of elevation (the Pond ridge,) from which it is situated in a direc-

tion about E. by S. This dike presents a series of curves, in its course, with their convexity to the East, in a direction contrary to that of the curves, connected with the Secondary. These curves apparently complete, or at least, correspond to the main curves of the Eastern line of elevation respectively. By referring to the map accompanying this report, it will be seen that the first curve of the dike is nearly coextensive with the Southern main curve of that line of elevation; the second, which includes three well marked subordinate curves, corresponds, in like manner, to the second main curve; the third, which terminates at a point nearly East of the S. point of the fourth main curve, corresponds to the third main curve, and all the remaining portion of the dike, to the fourth main curve. The particulars of this arrangement will be afterwards given, more in detail. The smaller (N. Western) dike, in the Eastern Primary, commences at a point about East by North from the S. point of Talcott Mt., one of the more important elevations of the Northern main curve of the Eastern line of elevation, in the Secondary. It thus corresponds to the Northern portion of that curve, (so far as I have traced it, only to that part of the same, S. of the Connecticut,) and, like the ridge to which it corresponds, presents no great deviation from a direct line, in its course. The two Western dikes, as has been already observed, recede from the Secondary, as they extend towards the South. The general outline of each presents a curve, convex to the East, like those already noticed, in the larger Eastern dike. They both exhibit interruptions and subordinate flexures in their course, which will be better explained, after a more detailed account of the same, as well as of the Trap connected with the Secondary formations.

The preceding remarks will serve to give a general view of the system of arrangement, which, I believe, I have been able to trace in the Trap rocks, connected both with the Secondary and Primary of the State. The observations I have made, have left a strong impression on my mind, that they are all parts of the same general system, and are derived from the

same source. Admitting them to be of igneous origin, of which there can be but little doubt, the central point of that action which has produced the Trap of the larger Secondary formation, and of the dikes connected with the Primary, was apparently in the larger Secondary formation, particularly in the Southern part of the same. The Trap of the Secondary is there much the most largely developed, presenting, with only one exception, that of Mt. Tom, the greatest elevations, as well as the greatest number of ridges and dikes. The dikes, connected with the Primary, are also most largely developed in the vicinity of that portion of the Secondary, and the most Northern of them approaches the latter formation South of its middle point. The larger Secondary formation may therefore be considered as having been originally a focus of volcanic action, in which the ridges and dikes of Trap now traversing it were ejected, in a certain systematic order, while the Trap dikes traversing the Primary were emitted through fissures, diverging from the Secondary, as a centre, in a similar order. The smaller Secondary formation may be considered as having been a similar volcanic focus, in which the ejection of the Trap was controlled by the same general laws. The Secondary formation, West of the Hudson, in New York and New Jersey, as well as the series of Sandstone with Trap extending farther S., in connexion with the Atlantic Primary region of the Middle and Southern States, and also the Secondary formation of Nova Scotia and New Brunswick, are probably of similar character with those within the limits of this State. The arrangement of the Trap in the former of these is analogous to that in the Secondary formations of this State, except that the order is reversed; the curves there presenting their convexity to the East, and that part of them which corresponds in its arrangement to the Southern portion of the curves in the Trap of this State, being there found at their Northern termination. Such at least is the view which I have formed, from a partial examination of the Trap connected with that formation. I have been able to judge of the ar-

rangement, in the Nova Scotia formation, only from an examination of maps, representing the mountain ridges, connected with the same. From those I have formed the opinion that the Trap ridges are there arranged in a manner conformable to the arrangement in the Secondary formations of this State, namely, with their convexity to the West.

It has already been observed that there is such a general resemblance in physical character, between the Trap rocks connected with both the Secondary and Primary of the State, as to indicate a common origin. Varieties occur peculiar to each, but others are found so entirely similar, that specimens from both localities could hardly be discriminated. The Trap of each of the four great dikes traversing the Primary, might be regarded as possessing a character in some respects peculiar. This is more particularly true of the two Eastern dikes; the Trap of the larger (S. Eastern) being generally coarser grained, and more nearly resembling the more usual variety of the Secondary ranges; that of the smaller (N. Western,) usually very fine-grained, with certain peculiar characters, which readily distinguish it from any other variety found in connexion either with the Primary or the Secondary. But similar differences may be observed between the Trap of different Secondary ranges, or of different parts of the same range, and in this way varieties may be observed in these ranges, more or less nearly allied to the Trap of the different dikes connected with the Primary. Thus, a coarse-grained Trap, very similar to that on the sides of the larger Eastern dike, may be observed in Mt. Carmel, and in the ridge East of Wallingford (third Eastern main curve.) The amygdaloidal variety, so frequent in the Trap connected with the Secondary, I have not found in any of the dikes traversing the Primary.

The Trap of the State may be divided into two classes, namely, compact and amygdaloidal; the latter, as already observed, found only in connexion with the Trap of the Secondary. The former of these is more crystalline, and is chiefly composed of hornblende and felspar, united in variable

proportions; sometimes the hornblende, and at other times the felspar predominating. This compact Trap varies in its grain from very coarse to minutely fine-grained. The coarser grained varieties are generally more decomposable, particularly a very coarse-grained variety, frequently found on the sides of the larger Eastern dike, and also at the Eastern point of Mt. Carmel, as well as in other localities in the larger Secondary formation. They usually, too, break in larger prismatic (jointed) fragments, which are rarely, however, as regular as the smaller fragments of the finer grained varieties. The more common variety, in the Secondary ranges, and in the larger Eastern dike, is moderately coarse-grained, but slightly decomposable, and usually breaks in rather large blocks. It has generally a predominance of hornblende in its composition. This and the coarser crystalline variety are most frequently observed in the middle part of the Trap ridges, connected with the Secondary.

Several varieties of fine-grained Trap may be noticed in connexion both with the Secondary and the Primary. The finest grained, connected with the Secondary, are generally dark blue or nearly black; the latter in some instances resembling basalt, but with usually a more crystalline grain. These finer grained varieties generally break in smaller and more regular prismatic fragments; occasionally presenting very distinct hexahedral prisms, but usually with unequal sides, and less uniformly arranged in columns, than basalt. More usually these finer grained varieties are divided by nearly vertical cleavages, in the general direction of the range, and transversely; in a few rarer instances, as in some points along the West side of Toket Mt., into large flat thin plates, the transverse cleavages being there less frequent, but more generally into long slender quadrilateral prisms, by more frequent transverse cleavages. These more prismatic varieties of fine-grained Trap are more usually found on the sides or near the extremities of the Secondary ranges. A variety of very dark fine-grained Trap is also observed in the ranges connected with

the Secondary, generally composed of rather small more cubical fragments, cemented usually into a very firm and indestructible mass, by some foreign mineral, most frequently quartz, but occasionally agate or chalcedony. Seams of hyalite also sometimes occur in this variety. It is found in different localities, both in the larger and smaller ranges. Among the former, it occurs particularly in the fourth Eastern main curve (range of the Hanging Hills.) Large bowlders of the same, perhaps from that range, are not unfrequently found scattered over the Southern part of the larger Secondary formation, and the adjoining part of the Western Primary. The fragments in these, as well as in the range from which they are apparently derived, are usually less small and regular, and the Trap less fine-grained, than in a corresponding variety found in some of the smaller anterior ridges of the first Eastern main curve, in East Haven. The latter consists of very small and regular fragments, usually connected by a very firm siliceous cement, which sometimes, however, is pyritiferous and decomposable, causing the disintegration of the rock in very ferruginous fragments. A fine-grained, light greenish grey variety, very slightly ferruginous, and often nearly white on its weathered surface, occasionally occurs in the Secondary ranges, particularly in the N. Eastern part of the Pond Ridge (first Eastern main curve.)

The Trap of the two Western dikes is usually fine-grained and rather light grey, breaking in rather large regular blocks, less ferruginous on the surface than the Trap of the Secondary ranges generally. Occasionally a coarse-grained variety occurs, particularly in the more Western dike, similar to that in the larger Eastern dike. The Trap of the N. Western dike, in the Eastern Primary, is a very peculiar fine-grained variety, no exact representative of which has been observed in the Secondary ranges. It is particularly characterized by a peculiar light brick red coating, frequently occurring on its weathered surface, and by occasional nodules or rounded porphyritic points of a compact greenish felspar, imbedded in it.

The Amygdaloidal varieties of Trap generally occupy the lateral portions of the Trap ridges, accompanying the Secondary, and occasionally compose entirely some of the lateral ridges subordinate to the main lines of elevation. The more common variety is more or less porous, generally with a coarse dark green ground, but occasionally with a fine light green ground; containing, in its cavities, different accessory minerals, varying in different localities, of which the most common are quartz (crystallized,) agates, carbonate of lime, datholite and chlorite. The latter is generally very dark and compact, entirely occupying the cavities, but occasionally these are found lined with very delicate light green crystals of the same mineral. The pores of this variety of Amygdaloid, in different ridges connected with the fourth Eastern main curve, are sometimes occupied by a shining black indurated bitumen, somewhat resembling anthracite in its appearance. This variety of Amygdaloid generally breaks into irregular flat fragments, by seams parallel to the inclined surface of the ridges, (or to the overlying or underlying Sandstone,) and is usually very ferruginous and decomposable. A more compact variety not unfrequently occurs, of a light green color, breaking into rather large irregular blocks, or thicker fragments, and usually less ferruginous and decomposable than the preceding. It is not porous like the preceding variety, but is more or less filled with small, often minute points of black compact chlorite. A variety of amygdaloid also occurs, breaking by cleavages into very small and sometimes even minute prismatic fragments. This is usually light green, and compactly fine, like wacke, with the same minute black points disseminated as in the preceding. Another variety, more resembling the porous variety, first noticed, breaks into small irregular rounded fragments, like gravel, often cleaving in concentric coats, and in such cases usually including a nucleus of some foreign mineral. Not unfrequently the compact Trap, particularly in the smaller ridges, and in the more lateral portions of the larger ridges, also cleaves in concentric coats, and is then usually marked by

blue or purple iron stains. The Trap is then, too, usually fine-grained and very hard, and the fragments much larger than those of the variety of amygdaloid, just noticed.

Trap Breccias or Conglomerates occur in different localities, in the same lateral position, in regard to the compact (crystalline) Trap, as the Amygdaloids. A peculiar variety, highly ferruginous, and often traversed by seams of hyalite, extends along the East side of a lateral ridge, parallel to Toket Mountain, on the West. Another variety, consisting of large and small fragments of a green, rather fine-grained sub-amygdaloidal Trap, cemented by a reddish brown indurated clay, resembling hard burnt brick, is found in a lateral ridge, anterior to the fourth Eastern main curve, in Granby. The South copper mine is situated in this rock, and the Newgate Mine in the Sandstone, underlying the same ridge, at its Northern extremity. A singular variety of very fine-grained, compact Trap, of a light blue colour, chiefly composed of compact felspar, highly ferruginous, and often filled to a considerable depth from the surface with a yellow ochre, is found in the same relative position to the main Trap ridges, as the amygdaloid, with which it is more properly connected. It occurs in a series of lateral ridges, fronting the N. E. point of Toket Mountain, on the North, in the S. part of Durham, and also at the North point of the Trap Conglomerate ridge, in Granby, just South of the Newgate Mine.

A variety of dark or light grey compact fetid Limestone is found in different localities, on the back of an anterior lateral ridge of Amygdaloid, nearly contiguous to the main Eastern line of elevation, at least from the N. W. point of Toket Mountain, N. E. of Northford, to a point East of Farmington meeting-house. It is apparently in immediate contact with the amygdaloid, and often the two rocks appear mutually indenting each other and firmly cemented. The limestone is apparently as little stratified as the amygdaloid, and generally breaks in equally prismatic fragments. Nodules of a similar light grey compact limestone have been observed, imbedded

as if in geodic cavities, in the Sandstone, West of Wallingford.

The Trap dikes, traversing the Primary, are coated on their sides, where they adjoin the including Primary rocks, by a band, usually of little thickness, of a dark blue (nearly black) compactly fine wacke-like substance, usually very hard and undecomposable, and with minute points of glassy felspar more or less frequently disseminated. This Wacke is usually most developed in the smaller dikes, and occasionally entirely composes small parallel bands or veins of Trap, traversing the Primary immediately adjoining the larger dikes. Sometimes, where the dike is very narrow, particularly where it runs out, as it were, at the termination of its detached elevations, it is composed of a very fine-grained, dark grey Trap, approaching the Wacke, in is character, but with a distinctly crystalline grain. This is particularly the case in the Western dike, traversing the Western Primary. A similar Wacke also occurs at the point where the Trap of the Secondary adjoins the including shale or sandstone, but usually of a greenish tint, and more earthy and chloritic.

The compact crystalline Trap, more particularly that of the dikes, traversing the Primary, usually contains less of foreign (accessory) minerals, than the Amygdaloid. Those accompanying the latter have been already noticed. Those accompanying the compact Trap usually occupy geodes, sometimes quite large, or seams between the blocks or fragments, and sometimes large or small veins. The minerals usually occurring in these locations are quartz, agate, prehnite, sulphate of barytes, calcareous spar and chlorite. Zeolite and stilbite have been found on the sides of the dikes traversing the Western Primary.

The association of metals with the Trap, in the Secondary formations, is here worthy of notice. All the metallic veins, yet discovered in those formations, are found either in the Trap or in the shale or sandstone immediately adjoining. When they occur in the Trap, they are found in its lateral portions,

particularly in the amygdaloid. The metallic veins in the Trap usually have a matrix of sulphate of barytes, quartz and calcareous spar, and occasionally contain seams or nodules of indurated bitumen, similar to that already noticed, as occupying the pores in the amygdaloid. The ores accompanying these veins are the sulphurets of copper, lead, zinc and iron. That of copper is most frequent, particularly in a range extending along the W. side of the fourth Eastern main curve, and apparently continued S. in the same line along a smaller ridge of Trap, posterior to the Northern curve of the Southern Western line of elevation, thus including the copper mines of Granby, Avon, Southington, Cheshire and Hamden. I have not observed any satisfactory indications of a similar association of metallic veins with the Trap dikes, traversing the Primary.

The Trap, accompanying both the Primary and Secondary, has produced changes in the rocks immediately adjoining, such as obviously indicate its igneous origin, namely, induration, semi-fusion, discoloration, and a greater tendency to a prismatic or jointed structure. Characteristic minerals are also occasionally found in the altered rocks, adjoining the Trap, both in the Primary and Secondary ranges, namely, in the former, zeolite and stilbite, and in the latter, beside the metallic ores already noticed, hyalite, epidote, chlorite, brown and fluor spar, and indurated bitumen. The Primary rocks generally present less appearance of alteration, than the Secondary, though some remarkable exceptions occur, particularly in the chloritic and micaceous rocks. Thus, the soft green Chlorite Slate of (A W.) is converted into a hard, black or purple flinty slate; Mica Slate, and Micaceous Gneiss, are rendered hard, black or bluish, with an enamelled or jaspoid appearance; Granitic (felspathic) rocks are indurated, darker coloured (bluish or greenish,) with a fracture approaching that of porphyry. The Secondary rocks present similar alterations, varying with their peculiar character. Thus, the coarser grained more felspathic Sandstones are indurated, and render-

ed more prismatic, often resembling closely, in that respect, the adjoining Trap. They are sometimes discoloured, greenish or brown, and at other times, their usual reddish colour is apparently discharged, leaving them nearly white. The discoloured varieties of these indurated sandstones often resemble very nearly, in general appearance, the indurated granitic rocks, accompanying the dikes in the Primary. The more argillaceous sandstones, when thus altered, often resemble, not a little, jaspers or porphyries of a red or purple colour. Fine specimens of such varieties may be found, in connexion with the range of West Rock (first S. W. main curve.) The Shales of the Secondary formations are generally converted into a light purple more indurated schist, resembling porcelain jasper, sometimes very compact, and at other times porous, like amygdaloid. This latter variety apparently depends on the peculiar character of the layers or beds from which it was derived, and not on its proximity to the Trap, as it often occurs more remote from the latter, while a very compact jaspoid variety is in immediate contact with it. In a few instances, where the Trap traverses the shale of those formations, it is immediately adjoined by a Trap breccia, composed of fragments, resembling the Trap of the ridge itself, cemented by a very hard, compactly fine, dark red jasper. Other varieties of altered sandstone and shale will be noticed in connexion with the ridges they accompany.

The dikes, traversing the Primary, have generally caused less disturbance in the strata, than might have been anticipated. Instances rarely occur, where the strata have been elevated or turned in a direction, contrary to their usual dip. More usually the Trap appears to have been injected into fissures, caused by the mere lateral displacement of the adjoining rocks. The Trap, accompanying the Secondary, has generally produced greater disturbances in the strata of the rocks adjoining. The sandstone or shale, overlying the inclined ridges, is usually more or less elevated, and the direction, both of the overlying and underlying rocks, is very generally adapted to

that of the Trap ridges they accompany. In some instances, in dikes, and at the termination of inclined ridges, where they apparently run out in dikes, the strata are turned, on their opposite sides, in different directions; on the Eastern side, more elevated than their usual dip, and on the Western side, changed from their usual Eastern to a Western dip. Where the dikes cross the strata nearly directly, there is usually less disturbance in the latter; the fissures having apparently been formed by lateral displacement, as in the case of the Primary dikes. In some instances of this kind, however, where the dike deviates somewhat from a vertical position, there is a corresponding elevation of the strata, on the back of it, in a direction at right angles to that of the dike.

Two phenomena, of a remarkable character, apparently connected with the Trap System of the larger Secondary formation, may here be noticed. In Berlin and Hartford, several apparent dikes have been observed in the shale, which there predominates, composed of indurated clay, with seams of crystalline quartz and sulphate of barytes, and with points of bitumen disseminated, as already noticed in a variety of amygdaloid, in the same section of the Secondary. These dikes are accompanied by brown and bituminous shale, in which are also included seams of bitumen, with brown spar, and sometimes with fluor. They have disturbed the strata of the adjoining rocks, in the same manner as the dikes of Trap, particularly those at the termination of inclined ridges; the strata, on the West side, being inclined in that direction. They are, most of them, too, apparently in the direction of ridges or dikes of Trap, beyond the point of their termination on the surface; thus indicating the presence of the Trap at a greater or less depth, below the surface. In Cheshire, a remarkable range of nearly vertical dikes or veins of sulphate of barytes, extends nearly from West to East, across the strata, in a direction parallel to a Trap dike, about half a mile farther South, already noticed among the Trap ranges, posterior to the Northern S. W. main curve, as apparently conformable to the

range of Mt. Carmel, anteriorly. Copper is found disseminated in the barytes of this range, as well as in connexion with the dike, to which it is parallel.

The Trap ranges, accompanying the Secondary, as has been already observed, conform, in their arrangement, to that of the Sandstone, and indeed have apparently exercised a controlling influence on the arrangement of the latter, thus indicating a contemporary origin. The Trap dikes, traversing the Primary, on the contrary, present no apparent connexion in their arrangement, with that of the Primary, crossing the ranges and subordinate members of the latter indiscriminately, as has already been stated in the detailed account of the different Primary formations traversed by them. At the same time, these dikes correspond strikingly, in their general system of arrangement, with that of the Trap accompanying the larger Secondary formation. The sandstones of the Secondary are also formed from fragments of the Primary, and frequently these fragments can be traced distinctly to the particular Primary ranges, from which they have been derived. It would therefore seem not improbable that the Trap of these dikes was derived from the same source, and ejected at the same general period as that accompanying the Secondary. The system of arrangement, in the latter, is more complete, than that of the dikes, and indeed may be considered as the centre of the same general system, of which the latter is only the outwork. The whole will thus be more clearly understood, by commencing with the detailed account of the ranges connected with the Secondary, and closing with that of the dikes, as an appendix. If in the following more particular account of the different ranges and dikes of Trap, in the systems above referred to, I should introduce all the details, which I have collected in my explorations, or even those which I have indicated in the accompanying map, it would lead me far beyond the limits of this report. I can therefore only give a summary view of the more important and interesting particulars, reserving the remainder perhaps to a better opportunity.

The more general outline of the entire system of arrangement of the Trap has already been given in the preceding statement. In the following detail, I shall commence with the system, connected with the larger Secondary formation, as the most complete and illustrative; then introduce that of the smaller Secondary formation, as more nearly resembling it, in its arrangement and character; and close with the dikes connected with the Primary.

I. The Trap System of the Larger Secondary Formation.

This formation, as has already been observed, is divided into two subordinate formations, or basins, each of which contains its separate subordinate Trap System. Of these the *Southern* is the largest and most important. The Trap System of the Southern basin, presents, as already stated, two main lines of elevation, an Eastern, larger and more complete, and a Western, smaller and apparently subordinate. Each of these consists of a series of curvilinear ranges, succeeding each other in a certain order, and more or less accompanied with parallel anterior and posterior lateral ranges. The Eastern Line of Elevation consists of a series of four main curves, gradually increasing in extent and general magnitude, from South to North. The Western Line of Elevation also presents four main curves, in two detached pairs or sections, but in reverse order; the more Southern curves, as well as section, being the largest.

E. *The Eastern Line of Elevation.*

(E. I.) The *Southern Main Curve* of the Eastern line of elevation, as has already been noticed, forms a very complete and well marked curve, commencing and terminating nearly in contact with the Western border of the Eastern Primary, and receding from the same, in its middle portion, to a distance of nearly two miles. It commences on the South at the point where Farm river (East Haven) enters the Eastern Primary,

and is there apparently in contact with a low ledge of granite (A E.,) situated at the base of its ridge, or is only separated from it by a thin bed of sandstone, there concealed by diluvium. From this point it advances N. W. in an unbroken ridge to the outlet of Saltonstall's Pond, where it advances abruptly West, leaving a passage for the outlet, and presents at the Branford road the appearance of a dike, bordered by a coarse altered sandstone, filled with seams of chlorite. It is then continued Northerly, along the West side of the pond, presenting near the middle of the latter a remarkable curve to the East, and at the North end of the pond bends rather abruptly East to the Branford and Foxon road, where a new subordinate curve commences, and continues Easterly to the N. E. point of the range, presenting a strong flexure to the South, at its extremity. The present range thus includes three well marked subordinate curves, namely, from its South termination to the middle of the pond, from that point to the Foxon road, and thence to its N. E. termination. These are more worthy of note, as they may be traced more or less distinctly, either in its anterior or posterior ridges, or in both. From near the outlet of Saltonstall's Pond to its N. E. termination, it forms an uninterrupted ridge, with only very slight depressions on its summit, the most considerable at the commencement of its third subordinate curve. In that part of it, adjoining the pond on the West, it presents a narrow summit, with a steeply inclined Eastern declivity, and with its abrupt declivity on the West, partly concealed by diluvium, and in its N. E. part, particularly its third curve, a broad flat tabular summit, with nearly abrupt declivities in both directions. The trap of this ridge is partly compact, and partly amygdaloidal. The former variety is occasionally fine-grained, light green, and nearly white on its weathered surface, from the predominance of felspar. This ridge is bordered, both anteriorly and posteriorly, by a very complete system of lateral ridges, corresponding to it in range and curvature. Three distinct ranges border it anteriorly, and two posteriorly. The two

latter might perhaps be considered as only one range, forming almost a complete curve. The first of these forms a parallel curve, included within the main curve, and apparently concentric to it, terminating also, at its two extremities, only at a short distance from the Eastern Primary. The second forms a much shorter and slightly curved ridge, distinctly convex to the East, and extending along the Eastern border of the Secondary, in the interval between the two extremities of the preceding.

(P. 1.) The First (Western) Posterior range commences on the Eastern border of the Secondary, at a point E. N. E. of the South point of the main curve, and at a greater distance from the Primary. It forms, at its commencement, a more complete curve than the main range, bearing around even to the N. East, in a line parallel to the frontier of the Primary, and directed towards the S. W. point of the second posterior range. It conforms in its course very nearly to the main curve, presenting a similar interruption, opposite the outlet of the pond, at the Saltonstall farm, bending East opposite the middle of the pond, and again near the North point of the latter, whence it continues nearly East to its N. Eastern termination. It terminates in that direction against the West front of a range of peculiar Conglomerate, extending along the Eastern border of the Secondary, in which traces of a Trap dike may be observed along its Western declivity. This conglomerate is usually very coarse-grained, and is composed of angular fragments of Primary rocks, which can generally be referred to the adjoining Eastern Primary (A 1—B 3,) usually much iron stained, and blended, more or less, with fragments of a fine-grained light green sub-amygdaloidal trap, similar to that of the range in question. This does not apparently curve South at its extremity, but in a direction South from that point, in a valley, there separating the Secondary from the Primary, is a small elevation of a highly ferruginous, very fragmentary amygdaloid, filled with glazed chloritic seams; apparently indicating a curve of this range to the South, to-

wards the N. E. point of the second posterior range. The Trap of the present range is more usually fine-grained, sub-amygdaloidal, and small fragmentary. The range itself is rarely of much elevation, and often presents the appearance of a well marked dike.

(P. 2.) The Second (Eastern) Posterior range, as already observed, extends along the Eastern border of the Secondary, in the line of the two extremities of the preceding. It commences at a point North of the Branford road, and extends nearly to the Foxon road above referred to. At its Northern termination it presents a slight flexure West, distinctly receding from the Primary. It consists of a series of more or less detached elevations, abrupt to the East, corresponding to the direction of its convexity. It is composed in its more central part of a sub-amygdaloidal trap, usually small fragmentary, but towards its South point appearing as if massive, without cleavage, and laterally of a very fragmentary and decomposable amygdaloid, so ferruginous as to have been used as an iron ore, at the furnace in East Haven, before 1680. This ridge also appears, at different points, distinctly as a dike, bordered by a peculiar altered sandstone, often characterized by its brilliant variegated colours, particularly green and purple.

The first principal curve of the larger Eastern Trap dike, commences at a point E. by S. of the S. point of the Main Curve (E. I,) and of that of its first posterior range, and terminates at a point nearly E. S. E. of the N. E. termination of the main curve. This curve of the dike, like that of the second posterior range, is distinctly convex East, and might thus be considered as completing the curvature of the main curve, in the same manner as the second posterior range apparently completes the curvature of the first.

The Anterior lateral ranges are less complete in their curvature, and correspond less exactly in their outline with the main curve, than the first posterior range. Like that, however, they form curves convex to the West, and parallel to the main curve exteriorly. Three distinct ranges may be traced,

the most Eastern of which corresponds most nearly to the main curve, but extends less far towards the South; that part of its range, corresponding to the S. termination of the main curve (South of the outlet of the pond,) being deficient. The two more Western ranges advance towards the West, at their Southern termination, instead of receding Eastward, as in the main curve; presenting a curve, receding, at its North point, into a line more conformable to the corresponding portion of the main curve (that from the outlet of the pond Northward.) At their N. E. termination, the anterior ranges all terminate much farther West than the main curve, and in a line nearly North of the commencement of the third subordinate curve of the latter. This repression of the anterior ranges is caused by the advance at the South point of the Second Main Curve (Toket Mt.)

(A. 1.) The First (Eastern) Anterior range commences in an abrupt point of amygdaloidal Trap, North of East Haven meeting-house, noted for its agates, and corresponding to the South point of that part of the main curve West of the pond. It extends Northerly, in a steep narrow ridge, along the West side of the valley of Farm river, corresponding very nearly, in its range, to the main curve, on the East side of the same valley, but more interrupted, particularly towards the North. It bends East near the middle point of this part of its course, opposite the flexure in the main curve, near the middle of the pond, and at this point is deeply intersected. This ridge terminates towards the North, in a detached summit, W. S. W. from the N. W. point of the main curve. After an interval, in which only a small dike is observed, in advancing order, the range again commences, just South of the Essex Turnpike, in a subordinate curve, strongly marked towards the South, and presenting, in a part of its course, a double line of similarly curved elevations. This extends N. N. Easterly to the S. W. termination of a remarkable ridge (†,) in the same general range, at a point N. W. from the N. W. point of the main curve. In the ridge last referred to, the range bends

Eastward rather abruptly, and continues in that direction to the West side of Farm river, in Foxon, (an extensive basin, included between the third curve of the Pond ridge on the South, Toket Mountain on the East, and the East points of the anterior ranges of (E. I,) on the West.) The ridge (†) at the point where the range bends East, presents two distinct lines of elevation, so arranged as to inclose a series of connected circular hollows, somewhat analogous to craters, but apparently formed in a manner peculiar to the Trap system.* Farther East the range is crossed by a valley opening East, along the North side of which it is continued to a high bluff, overlooking the basin, above noticed, on the East. This range, from the point where it bends East, is accompanied by two parallel ridges on the South, N. of the valley of Farm river, which there bends West, around the N. W. point of the main curve. These ridges commence in low dike-like points, and extending Easterly, terminate in much higher elevations on the West side of the Foxon basin. This is particularly true of the Northern of these ridges, which terminates in a high point, nearly South of the Eastern termination of the main line of the present range. The Southern ridge curves abruptly to the South, at its Eastern termination, crossing the Essex Turnpike in a low swell, near its South point, and is continued farther East in a strongly curved ridge, to the point where Farm river flows West from the Foxon basin, at a point S. S. E. of the East point of the Northern ridge. The Trap of this range is more generally compact, fine-grained and small prismatic, occasionally cemented by seams, usually quartzose, as already noticed in the preceding general remarks,

* These circular hollows are formed by two parallel lines of elevations; one on the South, in which the hummocks succeed each other more nearly in continued order, and in the general line of direction of the range; the other on the North, in which the hummocks are arranged in receding order, their S. W. points approaching the Southern line, and thus separating the included hollows more or less completely. The hummocks in the Northern line are separated from each other more or less distinctly by sandstone, more particularly observable at their S. W. extremity.

and often very ferruginous and disintegrated. Porous amygdaloid also occurs, particularly in its lateral portions, occasionally including fine agates in seams and nodules.

(A. 2.) The Second (Middle) Anterior range commences in two low detached elevations, in receding order, on the N. side of the peat-swamp basin, West of East Haven village, whence it extends E. N. Easterly, in a series of strongly receding elevations, along the South points of two or three sandstone ridges, N. of the same basin. In this part of its course, it apparently forms the N. E. termination of a curve parallel and conformable to that at the Southern termination of the Western Anterior range; the Southern main portion of this curve being deficient, as has been already observed of the Southern termination of the range (A. 1.) The present range then bears more N. N. Easterly, in a line more nearly parallel to the S. part of the preceding range (A. 1.) It then bends Easterly, conformably to the Eastern bend, noticed at that point, in the main curve, and in (A. 1,) and like the latter, is deeply intersected, at the point where it again bends Northward. At this latter point, it advances abruptly to the West; this peculiarity being but slightly obvious in (A. 1,) and still less so, in the main curve. It then extends N. in a series of small dike-like ridges, along the summit of a tabular ridge of sandstone, to the Essex Turnpike, North of which it rises abruptly in a rounded summit, presenting apparently three distinct lines of elevations, curving N. Easterly, and then recedes Easterly in a similar lower summit, approaching near the West front of the range (A. 1,) not far S. W. of its bend Eastward. Farther North, the present range is continued N. N. E. in advance of the N. W. point of the latter summit, in a narrow ridge, in receding order, terminating nearly in contact with the third anterior range, at a point to be hereafter specified. The Trap of this range resembles, on the whole, that of the preceding range, but is usually less amygdaloidal.

(A. 3.) The Third (Western) Anterior range is more extensive and more complex in its arrangement, and less conforma-

ble, in that respect, to the main curve, than either of the preceding. It includes all the elevations of Trap, connected with the system of the Main Curve (E. I,) on the West, adjoining the valley of the Quinipiack. It consists properly of two subordinate sections, North and South of a line, drawn Westerly from the flexure in the main curve, West of Saltonstall's Pond, and passing through the intersections, already noticed in the two preceding ranges. The Southern of these is more involved in the sandstone, and presents more frequently the appearance of a series of dikes, than the Northern. The latter extends in a higher and more uninterrupted range of Trap elevations, along the immediate border of the valley, above mentioned, and of a branch of the same extending Eastward, forming a strongly marked curve, particularly towards the North.

The Southern section presents, at its Southern termination, a subordinate range (†,) apparently forming a complete circle, inclosing a central tract of sandstone. This range extends W. N. W. from its most Southern point, along the N. shore of Morris' Cove (New Haven Harbour,) in a long mural ridge (Black Rock,) rising directly from the coast. This terminates towards the West in a low dike-like swell, bearing around more to the N. West. Farther West, in the same line of direction as the ridge at Black Rock, the range appears again in the detached rock, on which Fort Hale is situated, whence it extends, in a line of low, occasionally dike-like elevations, N. N. Easterly to Prospect Hill, being interrupted or concealed by diluvium, for a short distance S. W. of the latter point. It occupies the summit of the elevation last mentioned, and may be traced, after a short interruption, S. S. East from that point, along the East side of another high ridge of Sandstone, where it appears as a dike, partly exposed on the East. Farther S. it is continued in a line of more detached low ridges, bending S. Westerly, to the East point of Black Rock, thus completing the curve. This offers a more complete example of an entire curve, of any great extent, than any I have

observed in either of the Trap Systems of the State. Its isolated position, on a detached range of sandstone, bordered by New Haven Harbour on the West and South, and on the East by the basin of East Haven, between the elevations connected with the main curve (E. I) and the two preceding Anterior ranges (A. 1—2,) on the North, and the Primary (A 1 E.,) on the South, has probably contributed to its more perfect development.

In advance of the N. point of this range, at Prospect Hill, a lower range of sandstone (:) extends North, crossing the East Haven road, East of the plain adjoining the mouth of the Quinipiack. This latter range is traversed by a series of Trap dikes, forming two subordinate ranges, an Eastern, and a Western, accompanying two parallel ridges of sandstone. The Western range presents five distinct parallel dikes, at the passage of the East Haven road; the Eastern only one, of greater width, just S. of the same road. The dikes, in the former, are arranged in a manner similar to the ordinary ridges of Trap, in a series of more or less detached points, subject to lateral shifts, and presenting a similar order of succession. The whole series also presents a distinctly marked curvature, convex to the West, as usual. A low ridge of sandstone rises in advance of the N. point of the Western range, around the S. point of which extends a dike of Trap, continued N. a short distance, along its Western front. This dike was apparently the agent in elevating the sandstone, the ridge being somewhat higher and more abrupt at its Southern termination. The Western dike-range thus advances at its N. extremity, and in a direction too towards the S. E. point of the Western line of elevation, at East Rock. The Eastern dike-range recedes from the point, above noticed, and extends N. N. E. along the East side of a higher ridge of sandstone, in the same manner as has been noticed in the ridge S. E. of Prospect Hill, and at its N. E. point bends abruptly, in a low detached swell, towards the East.

The curve farther South, and the Eastern dike-range, may

be considered as forming together a larger curve, corresponding to that part of the Main Curve (E. I,) South of the outlet of Saltonstall's Pond, but advancing West, while that recedes to the East, thus leaving the East Haven basin between them. The flexure Eastward at the N. point of this larger curve corresponds to that portion of the Second Anterior range, at its Southern extremity, receding Eastward.

North and N. E. of the N. point of the Eastern dike-range, the country is occupied by a series of sandstone ridges, extending Northward, E. of Fair Haven. Among these, N. E. from the same point of the dike-range, extends a small range of Trap (*,) apparently a continuation of the same series as the latter. This commences on the West side of the first sandstone ridge, to which the second anterior range is attached at its Southern extremity, but at a considerable distance Northward, in which interval no Trap is observable. It extends N. to a high rounded summit of Trap, and then bends E. N. E., terminating at a low point nearly West of the intersections, noticed in the two preceding anterior ranges, at their bend Eastward. This smaller range corresponds to the Southern portion of the first anterior range, and to the corresponding portion of the second. North of this smaller range and of the sandstone ridges, East of Fair Haven, a transverse valley extends Eastward, continued across the two preceding anterior ranges (A. 1—2,) at their intersections, to the valley of Farm river. This valley is much wider, on the West, separating the Northern and Southern sections of the Western Anterior range (A. 3.)

On the North side of this valley, rises an abrupt elevation of Trap, forming a strongly marked curve, at the Southern point of the Northern section of (A. 3.) A small point of Trap in the valley above mentioned, is interposed between it and the N. W. point of the last curve (*) in the Southern section. This elevation, at the S. point of the Northern section, rises abruptly, N. E. of Fair Haven, and curves around towards the N. E. till it meets a projection from the sandstone ridge accompanying the second anterior range, S. of the Essex Turn-

pike. On the West, it bears more directly North, in the general line of the Western range, soon terminating in a dike-ridge, crossing the Essex Turnpike, at the gorge where it enters the hills, N. E. of Fair Haven. This line of the Western range is continued N. usually in dike-like elevations of Trap, more or less involved in the sandstone, to a transverse valley, opening S. E., not far South of which the Trap presents an abrupt ridge, of nearly equal elevation with that at the S. point of the present section. North of the valley, last mentioned, the Trap is continued, in receding order, in a series of apparent dikes, traversing the Western border of a tabular ridge of sandstone. At the South point of the latter, are two parallel ranges of Trap, both apparently forming strongly marked curves at their South points; the Western soon terminating near the base of the sandstone ridge; the Eastern continued along the summit, in the general line of the main Western range. At the S. E. point of the Western of these ranges, a low swell occurs, in which is a nearly circular dike of very small fragmentary light green wacke-like Trap, inclosing a fine-grained indurated and similarly small fragmentary sandstone. In a parallel ridge, farther East, in a direction E. S. E. from the S. E. point of the Eastern of these ranges, is another small dike-like range of Trap, interposed between the Western anterior range, and the elevation in the second anterior range, N. of the Essex Turnpike. At the N. point of the most Eastern of the two ranges, above noticed, the Western main range is continued in a long elevated ridge of Trap, abrupt to the West, and sloping steeply East to a valley, opening N. W. On the Eastern declivity of this latter ridge, is a low apparently dike-like elevation of Trap, including, near its sides, detached masses of an indurated very granitic sandstone.

The Northern section, thus far, is directed N. N. Easterly, along the East border of the Quinipiack valley, and presents two well marked subordinate curves, most strongly marked towards their Southern termination, and at that point approaching the second anterior range, near the elevation of the latter,

above referred to. In this part of its course, it is preceded by an anterior parallel subordinate range (††,) rising in a detached ridge, in the plain N. of Fair Haven. This range of Trap extends along the summit of the ridge, forming its highest point; but towards the two extremities, in several points, is inferior in elevation to the sandstone. It has generally the appearance of a dike, and very distinctly so, towards its extremities, but is arranged in a series of elevations, conforming in their order of succession to the general arrangement of the Trap ridges. At its Southern extremity, it terminates in a depression, or ravine, bordered by abrupt walls of indurated sandstone. At the gorge of the Essex Turnpike, above noticed, an inclined dike appears in the sandstone, West of the main line of the Western range, from which a small dike-like range of Trap may be traced N. Westerly, across the plain, nearly to the highest point of the subordinate range, last mentioned, and on the opposite (W.) side of the same point of that range, a similar dike-like range extends W. N. W. to the borders of the Quinipiack marshes, at the Middletown Turnpike. At the latter point, several small dikes occur in the sandstone, one of which, cutting across the sandstone obliquely, has apparently carried up one of the lower strata of the latter, on its upper surface, nearly to the summit of the ledge. This point of Trap is nearly opposite the S. E. point of the range of East Rock, in the Western line of elevation. A smaller detached ridge of Trap (‖,) in the line of the subordinate anterior ridge, last noticed, but in receding order, extends along the E. side of the North Haven road, fronting the middle part of the Northern of the two curves, in the main line of the Western range (A. 3,) above mentioned. A small and very irregular, interrupted dike extends N. Westerly from a point in advance of the Western of the two ranges at the S. end of the Northern curve, above referred to, nearly to the S. point of this anterior ridge, connecting it with the main Western range, in nearly the same manner, as that already noticed, connects the Southern anterior ridge with the same range.

North of the valley, opening N. W. across the main Western range, and nearly in the line of the ridge, South of the same, but in a direction more N. Easterly, rises a high detached summit of Trap (High Rock,) forming the N. W. point of the range. The Western anterior range then recedes to a point, S. E. of this summit, whence it extends, in an Easterly direction, in a mountain ridge, nearly equal to the main curve (Pond ridge,) in elevation and general magnitude. It presents there two leading curves, separated by a transverse valley, across which the S. W. point of the second curve is continued in a low dike-like ridge. The Western curve terminates opposite the N. point of the second anterior range (A. 2,) and projects there to the South, in an outwork of low rounded hummocks of small fragmentary sub-amygdaloidal Trap. The second curve commences, as has been noticed, on the N. E. side of this outwork, and apparently in the line of the second anterior range, but in a direction more E. N. E. It terminates towards the East, in a high castellated point of Trap, N. W. from the N. E. point of the first anterior range (A. 1.) From this point it bends abruptly South, in a lower ridge, bearing around to the West, by the North front of the crater-like ridge (†,) in the N. E. part of (A. 1,) and at last approaches near its commencement, on the West, thus forming a nearly complete circle, inclosing a swampy basin in its centre. This Eastern curve, in its Northern half, forms a high narrow ridge, but in its Southern half, is much lower, and towards the S. W. scarcely elevated above the surface. It might, from its direction, be regarded as a continuation of the second anterior range (A. 2,) though in the line of elevation of the Western range (A. 3.)

The Trap of the Western anterior range more generally resembles that of the main curve, being less amygdaloidal than that of the other lateral ranges. It presents several interesting varieties of indurated sandstone adjoining it, particularly in the dike-range, on the East Haven road, and in some parts of the Northern section. The sandstone in the dike-range often abounds in red felspar, which, in the indurated portions, has a

peculiar enamelled appearance, resembling that of some porphyries. A peculiar variety of a light ash coloured, rather fine-grained sandstone, somewhat resembling a trachyte, is found in contact with the Trap, at several points in the Northern section. The sandstone is most indurated and usually most discoloured in the detached masses of it, included in the lateral portions of the dikes.

The three anterior ranges apparently shift to the South, at their N. E. termination, where they may be considered as represented by the three parallel ridges, noticed in connexion with the N. E. termination of (A. 1,) each of which terminates in a more elevated point, marking the general curvature of the system of anterior ranges to the South, at its N. E. termination. This peculiar arrangement of the anterior ranges, so different from that of the main curve and its posterior ranges, is obviously caused by the intrusion of the second main curve and its anterior range, which has prevented the extension of the anterior ranges (A. 1—3,) farther E. than the commencement of the third curve of the main range (E. I.)

The general relations of the anterior ranges of the present system, to the main range, have already been pointed out. The first of these ranges conforms more exactly to the main range, than the two others, and the third least of all. This may be particularly observed in its change of direction at its Southern termination, and in its division into two distinct subordinate sections, approaching each other by two strongly marked opposing curves. The relations of the Western anterior range to the Western line of elevation (at East Rock,) are worthy of notice. It has been already observed that in two points it advances from its general line of direction, towards that line of elevation, namely, at the N. W. point of the dike-range (‡,) N. of the East Haven road, and in front of the South part of the Northern section, in the ridge (††) in the plain N. of Fair Haven, and in the outwork of the latter, on the Middletown Turnpike. This latter advance might be even considered a continuation of the Western line of elevation into the Eastern.

The remarkable elevation at the South point of the Northern section, and in the second anterior range, North of the Essex Turnpike, might be also connected with this continuation of the elevating force of the Western line, which would thus present a curve, at this point, convex to the South, conformably to the general arrangement of the Trap system. These remarks will suffice to give a general view of the arrangement of the first Eastern main curve and its lateral ranges. A complete detail of all its parts, and of their peculiarities and relations, would furnish materials for an extensive treatise itself, and one which, I doubt not, would offer many traits of great interest.

(E. II.) The *Second Main Curve* of the Eastern line of elevation,* resembles the First Main Curve (E. I) most nearly in the completeness of its curvature, and in its general outline. Like the latter curve, it commences on the S. W. near the Western border of the Eastern Primary, where it is separated from it by a valley of some width, and after making a large sweep, between North Guilford and Northford, receding in a similar manner from the Primary, it terminates towards the N. East, almost in immediate contact with the latter. The curvilinear outline of this, as well as that of the preceding main curve, when viewed from an elevation that commands the whole, is strikingly obvious. The present main curve exhibits in its course, two well marked subordinate curves, and a slight flexure in its Western front, corresponding to the larger flexure in the Western front of the first main curve. Throughout the greater part of its course it presents a very even tabular summit, wider than that of the Eastern curve of the Pond ridge, and is crossed by no deeply intersecting valleys. It commences in the S. W. part of North Branford village, where it bears around even to the N. East. From this point it sweeps around in a strong curve, opposite the N. E. point of the Pond ridge, from which it is separated by a wide valley opening E. S. E.; the two ranges merely approaching

* *Tokat Mt.*, so called from the aboriginal name of Branford (*Totokat.*)

each other without disturbance, (the only instance of the kind, in the Trap system of the larger Secondary formation.) At a point nearly N. of the N. E. termination of the Pond ridge, the present range bends N. somewhat abruptly, and continues in that direction to a point nearly E. of Northford meeting-house. It there recedes slightly, while a parallel appended ridge rises in advance, separated at its commencement by a deep valley, called the Den. The two ridges unite in one summit, at no great distance N. E., separated there only by a slight depression, occupied, however, by a sub-amygdaloidal Trap, still indicating the line of separation between them. Not far N. of the commencement of the advanced ridge, the range curves round E. N. E. to a point S. S. E. of the S. point of the third main curve. It then bends rather abruptly N. at the commencement of its Northern subordinate curve. At this point, on the S. side of the range, is an outwork of low hummocks of fragmentary amygdaloid, indicating the termination of the first subordinate curve, by a slight flexure South. The Northern curve is much more strongly marked than the Southern, presenting its convexity to the North, and even bending around to the S. W. at its N. Eastern termination, where it runs out in a low point of amygdaloid, similar to that noticed at its commencement. For some distance N. of this termination, it presents an abrupt mural front to the East (Bluff-Head,) opposite the range (B 3,) in the Eastern Primary.

The summit of the present main curve, though generally very even, usually exhibits a series of low elevations (hummocks) of Trap, in different parallel lines, and arranged according to some one of the orders of succession, noticed in the general remarks on the Trap system. These elevations are most distinct towards the two extremities of the range. In crossing the ridge transversely, the different parallel lines of elevations, will be found occupied by Trap of different varieties. A transverse section, near the middle of its Western front, will exhibit this arrangement, which will also apply, to some extent, to most other Trap ridges. Along the West side of the

ridge extends a band of fine-grained, dark grey, very prismatic Trap, which, at the point selected, also includes a lighter grey less fine-grained variety, cleaving in broad flat plates, by longitudinal vertical cleavages, and abounding in iron pyrites. Farther East is a band of coarser grained crystalline Trap, breaking in large square blocks, as is usual in the central part of the larger Trap ridges. Still farther East, we find a similar Trap, in smaller, less regular fragments; then a lighter green sub-amygdaloidal Trap, in irregular flat fragments; then a similar variety, more vesicular; then an iron-shot amygdaloid, breaking in concentrically scaling balls, and at last, a soft light green, small fragmentary amygdaloid, more or less vesicular, extending there to the base of the Eastern declivity, and overlaid by a friable red shale. The fine-grained prismatic Trap, on the West side of the range, often presents very complete prismatic forms, from trihedral to hexahedral, usually long and slender, and occasionally pointed, particularly the trihedral.

The present main curve, like the preceding, is accompanied by a corresponding system of anterior and posterior curves, less complete, however, and proportionally less extensive. Of these the posterior, as in the preceding system, are more exactly conformable, in their outline, to the main curve. They form only one range, consisting of two distinct curves, corresponding to the two leading curves of the main range, in the same general line of direction, but separated by a wide interval of sandstone. These, like the main range, begin and terminate, on the immediate Eastern border of the Secondary, and recede from it in like manner, but to a comparatively less distance.

(P. 1.) The Southern of these posterior ranges forms a well marked curve, of moderate extent, South of North Guilford meeting-house, with three or four subordinate curves, marked by transverse depressions. It commences, on the S. W., in a low point on the Eastern border of the Secondary, and terminates, on the N. East, in a bluff overhanging the valley of Guilford river, there separating the Secondary from the Prima-

ry. It is accompanied, particularly on the North, by a parallel range of coarse sandstone, presenting a series of elevations conformable to those of the Trap. The Trap of this range is generally rather fine-grained, greenish, sub-amygdaloidal, with peculiar light green chloritic seams, and with occasional small veins or seams of a red jaspoid substance. The Trap dike, traversing the adjoining part of the Eastern Primary, presents a curve, opposite this posterior range, apparently completing its curvature, in a similar manner to that already noticed in connexion with the first main curve (E. I.) The points of the two curves are nearly directly opposite each other; those of the dike curve bearing about S. E. from those of the present posterior range.

(P. 2.) The Northern Posterior range forms a more elevated ridge, called Quonipaug Mt., nearly of equal elevation, in its more Northern part, with the main curve (Toket Mt.) It commences, on the S. W., on the West side of the valley, there separating the Secondary from the Primary, in a small detached ridge of amygdaloid, crossing the West branch of Guilford river, at the point where it issues from the Secondary. This ridge is bordered, particularly at its S. point, where it approaches nearest the frontier of the Secondary, by a very coarse Conglomerate, formed of angular fragments of Primary rocks, which can generally be easily traced to the adjoining Primary ranges (B 3—2,) slightly cemented, and stained of a bright red, as if they had been subjected to strong igneous action. Receding East, across a ridge of sandstone, the main curve of the range commences in a low point adjoining the valley, above mentioned, whence it rises rapidly Northward to the high ridge, already noticed; narrow and more broken, towards the South, but with a broad tabular summit, like that of the main curve, towards the North, particularly after its bend Eastward. This ridge terminates, on the N. East, in a high bluff point (S. by W. of Bluff Head,) overhanging Quonipaug Pond, on the West. The excavation of the Guilford and Durham Turnpike along this declivity, exhibits the Trap at its

termination, as a dike, bordered by the same coarse red-stained conglomerate, observed at the Southern extremity of the range. This range, like the preceding, is bordered, particularly on the West, by lower ridges of sandstone, conforming to it, in their curvature. The Trap dike, in the adjoining Eastern Primary, also presents an apparently complementary curve, opposite the present posterior range, similar to that opposite the preceding. These two curves, in the dike, are subordinate portions of a larger curve, extending from the N. E. point of that already noticed as corresponding to the first main curve (E. I,) to the N. E. point of the one just referred to as corresponding to the present posterior range. This larger curve of the dike may be regarded as corresponding, in like manner, to the present main curve (E. II.)

The posterior ranges of the present system conform, in their general outline, to the two leading curves of the main range, but are situated more remotely from it, than the corresponding Western posterior range of (E. I) from its main range, and perhaps from that circumstance, do not present the continuous curve of the latter. Their situation, too, in the vicinity of the Primary, has prevented the development of a posterior range, corresponding to the Eastern posterior range of the first main curve, and complementary of their curvature. The opposite curves of the Primary dike, as already observed, stand to them in this relation.

The Anterior lateral ranges of the present system correspond less perfectly, in their outline and arrangement, with the main curve, than the posterior ranges; being disturbed, at their two extremities, by the intrusion of the adjoining systems, namely, those of the first and third main curves. They may be classed under two leading ranges, viz., an Exterior (Western,) and an Interior (Eastern) range. The Interior range conforms more exactly, in its outline, to the main curve, and like that consists of two leading subordinate curves, corresponding to the two leading curves of the latter, but like the two posterior ranges, separated by a wide interval, caused by the

intrusion of the South point of the third main curve (at Paug Mountain.) The Exterior range is not, like the exterior ranges of the first main curve, conformable in its course to the main range, but forms an independent curve, commencing opposite the middle point of the Southern curve of the latter, and terminating in front of the Southern part of the third main curve, thus forming, as it were, a connecting link between the systems belonging to the second and third main curves.

(A. 1 S.) The Southern curve of the Interior range commences on the S., in a detached elevation, rising nearly in the centre of the Foxon basin, and ranging W. N. W., nearly in the line of the most Southern portion of the main curve continued. This elevation, at its S. E. point, consists of a soft, very porous amygdaloid, but along its summit, it presents a range of the common crystalline Trap. It is continued N. Westerly, across Farm river, in a line of low swells, partly covered by diluvium, and partly exposing a peculiar dark green Trap conglomerate, accompanied with beds or dikes of amygdaloid and fine-grained small prismatic Trap. At a point nearly North of the N. E. point of (A. 1) of the preceding system, this range rises abruptly in a ridge, extending North, parallel to the main range of Toket Mountain, nearly to the middle point of the West front of the latter; consisting chiefly of a coarse greenish Trap conglomerate, usually very ferruginous, with beds or dikes, along its West front, of fine-grained small prismatic Trap, and porous amygdaloid, and along its Eastern declivity, of a peculiar ferruginous amygdaloidal conglomerate. Bog iron was formerly dug in a swamp, East of this ridge, in the Foxon basin, probably derived from its ferruginous conglomerates. This ridge, near its middle point, advances West, to nearly twice its former width, presenting a broad tabular summit, sloping North to its termination. On the middle of this summit extends a range of dark grey very hard Trap, and in a line from it South, in a low anterior terrace, a range of similar Trap, in a part of its course, obviously a dike, bordered, both East and West, by a coarse red sandstone, is continued

Southward, nearly to the South point of the present ridge. The West front of this ridge, after its advance Westward, is occupied by a very ferruginous fragmentary Trap, like that farther South. In advance of the South point of the anterior terrace of Trap, just noticed, and extending somewhat farther South, rises an isolated short ridge of Trap, similar to that of the terrace, from the North point of which a lower ridge of sandstone extends Northward, nearly to a line with the advance of the main ridge of the present range, Westward. West of the S. W. point of this advance, the Trap of the present range advances still abruptly West, in two detached elevations, by the N. point of the sandstone ridge, last noticed, and then extends North in a line of short detached ridges, soon bearing N. N. E. in receding order, to the South point of a high ridge N. N. W. of the North point of the preceding main ridge. This ridge extends North in the same line as the preceding, parallel to the main range of Toket Mountain, and is composed chiefly of a coarse red sandstone, with a ferruginous amygdaloidal conglomerate on its Eastern declivity, similar to that on the ridge farther South. At its S. W. termination is a point of Trap, in the line of the range, farther South, and from this a line of indurated sandstone is continued along the West side of its summit, to a low point of Trap near its Northern extremity. In front of this ridge, on a lower terrace, is a small range of Trap, commencing near the point of Trap, at its Southern termination, in advancing order, and forming a strongly marked curve towards the North. From the N. W. point of this latter range, a line of low elevations of Trap extends N. W. in advancing order, to the South point of the Exterior Anterior range, connecting it with the Interior range, in nearly the same manner as the anterior subordinate range of the Northern section of (A 3) of the preceding system, is connected with its main range.

The line of the Interior range is continued farther North, by a wide ridge of Sandstone, extending North to a point nearly West of Northford meeting-house. Along the West

side of its Southern portion, a range of greenish Trap conglomerate is observed in detached points, North of which the ridge advances West, South of the Middletown Turnpike, to a point of similar Trap conglomerate, including a central bed or dike of fine-grained small prismatic Trap. North of the Turnpike, in a line intermediate between the two Trap conglomerate ranges, farther South, rises a higher summit of a coarse light reddish grey sandstone, including two parallel dike-like ranges of small prismatic Trap, extending nearly to the North point of the ridge, above referred to. In a line N. N. E. from the last mentioned ridge, in receding order, rises another still wider ridge of Sandstone, North of Northford meeting-house, along the West side of which extends a small dike-like range of Trap (†,) nearly in the line of those last noticed, and connected, towards the North, with the Northern part of the Exterior range, as will be afterwards explained. The Interior range is properly continued in a short, but remarkable curve of Trap, rising in a detached ridge in the valley of Farm river, at a point W. N. W. of the South point of the appended ridge, in the range of Toket Mountain, at its bend Eastward. From this point this latter curve advances N. W. to the S. E. point of the sandstone ridge, last mentioned, where it extends along the West side of the Middletown Turnpike, in the form of a dike in the sandstone. It then recedes East, and extends along the East bank of Farm river, running out in a low swell of indurated sandstone, bending East, conformably to the curve of the main range (Toket Mountain.)

This Southern section of the Interior range presents, on the whole, a curve conformable to the Southern curve of the main range, extending Northerly, for the greater part of its distance, in a ridge parallel to the Western front of that curve, but receding more abruptly at its two extremities. This recession, at its Southern extremity, is apparently caused by the repelling force of the main and anterior ranges of the preceding system, as will be seen by a reference to the map accompanying this report, where the course of the different ranges, if unobstructed,

is represented by dotted lines. Its abrupt recession at its N. point is caused apparently by the dike-like range (†,) (connected with the Exterior range,) which conforms in its direction to the main curve of the third system.

This Southern section is particularly characterized by the predominance of Trap conglomerate in its Southern portion, especially in the most Southern of its three main ridges, and by the involution of the Trap in sandstone, in its Northern portion, except in the detached range at its N. E. extremity. A range of crystalline Trap may be traced through its Southern portion, as already detailed, but this is apparently directed N. W. to the South point of the Exterior range.

(A. 1 N.) The Northern curve of the Interior range, forms a low ridge, or terrace, very exactly parallel to the Northern curve of the main range (Toket Mountain.) It consists almost entirely of the peculiar light blue felspathic amygdaloid, already noticed, more or less vesicular, very ferruginous, and usually breaking in flat tile-like fragments. It commences on the S. W. in a more elevated point, nearly covered with diluvium, the amygdaloid being observed only on its Northern declivity. On its summit, towards the North, is situated Elliott's Limestone quarry, in a bed of light grey compact fetid limestone, usually breaking in small prismatic fragments. This limestone, as has already been observed, is apparently situated immediately on the back of the amygdaloid, and is partly impure, as if blended with the latter, and then more or less ferruginous. A deep valley crosses the ridge, just North of the quarry, on the North side of which I observed a thin bed of similar limestone distinctly included in the amygdaloid. Farther E., this anterior curve rather forms a terrace, fronting the main range of Toket Mountain, than a distinct ridge, and may be traced East to the valley separating the Secondary from the Primary, at a point North of Bluff Head. In the more Eastern part of it, it is partly composed of a ferruginous amygdaloidal conglomerate, similar to that on the East side of the Southern section of the present range, already noticed.

This anterior curve is separated from the main range, by a band of friable red shale, with beds of a light grey sandstone, and also including, in its S. W. part, near Elliott's quarry, a bed of bituminous shale, with thin layers of bituminous limestone, and in its Eastern part, N. W. of Bluff Head, seams of a peculiar indurated bitumen. An interval of considerable extent occurs between the Northern and Southern sections of the Interior range, in which no trap has been observed; the range being apparently interrupted by the intrusion of the South point of the third main curve, opposite the angle formed by the junction of the two leading curves of the present main range.

(A. 2.) The Exterior (Western) Anterior range, as already observed, may be regarded as forming a connecting link between the second and third systems of the Eastern line of elevation. Indeed, it is connected, in a continuous range, with a ridge of Trap distinctly anterior to the main curve of the third system, as will be afterwards explained. This range commences, on the South, on the W. side of the Middletown Turnpike, nearly on the line of North Haven and Northford. It there forms a short strongly marked curve, convex to the South, with which the advancing series of elevations, noticed in connexion with the Southern section of the Interior range, communicates near its Eastern termination. The last of these elevations crosses the Turnpike as a dike, and rising West of the road, curves North against the front of the present range. At this point, in the direct line of the Trap of this range, there is an interruption in its course, the interval being occupied by indurated sandstone, while the Trap extends behind the latter, in a line posterior to the general line of its course. Similar displacements occur in other parts of the Trap system, but none more striking or interesting than the present. At the West end of the curve, just noticed, the range bears around rather abruptly North, and is soon interrupted by the passage of a stream (Muddy Brook,) flowing in the immediate vicinity of this and the connected range of the third system, nearly from its source.

Farther North, the present range extends in a long slightly interrupted ridge, along the W. side of the valley of the stream, just noticed, towards which it presents an abrupt declivity, while on the opposite (West) side it is bordered by a parallel ridge of sandstone. The dike character of this ridge is distinctly obvious, in different parts of its course, particularly at the passage of the road from North Haven to Northford. At the North end of this ridge, the present range is more interrupted, bearing abruptly East, across the stream, above mentioned, and terminating in a singular detached and abrupt elevation, rising in the middle of the valley of the latter. The range, thus far, forms a curve, strongly marked at its two extremities, and but slightly so in its middle portion; commencing nearly opposite the slight recession in the West front of the second main range (Toket Mountain,) and terminating nearly W. of the S. point of the third main curve. Its general direction is nearly parallel to that of the Western front of the main range.

Farther N. the present range is continued in two high detached ridges, forming a shorter but more strongly marked curve, commencing somewhat in advance of the detached elevation, just noticed, and meeting, at its N. E. point, the dike-like range (†,) already noticed as extending N. in the line of the Southern section of the Interior range, along the W. side of the Sandstone ridge, N. of Northford meeting-house. This latter range (†) rarely rises much above the surface, and presents usually the distinct form of a dike, bordered by indurated sandstone. Just North of the road leading from Northford meeting-house to Wallingford, this range divaricates, sending off a branch to the N. W., which passes into the S. point of the Northern curve of the Exterior range, last described, just N. of the singular detached summit, at the N. point of the Southern curve of the same range. This branch consists of a series of short elevations (hummocks) of more or less indurated sandstone, succeeding each other in apparently irregular order, but with a general advance to the West. Singular varie-

ties of amygdaloid and green wacky Trap, as well as of Trap conglomerate, may be observed in connexion with this range. In some instances, the Trap appears in small rounded elevations, as if it had issued through a circular orifice. This branch uniting with the Northern curve, above noticed, serves to render its curve more complete. This Northern curve, thus formed, might be regarded as corresponding to the Northern curve of the main range of the present system. The Eastern branch of (†) first recedes slightly, in similar short elevations, to the S. point of a high ridge, along the summit of which it is continued Northward, descending rapidly, at the N. point of the same, to the stream above mentioned, in the vicinity of which the Trap appears distinctly as a dike. Farther N., this branch of the range rises to a long straight slightly interrupted ridge of Trap, abrupt on both sides, and terminating on the N. nearly E. of the N. point of the Northern curve of the Exterior range, above noticed. An elevation of Trap rises between the points of these two ranges, from which a range extends N. nearly in the line of the Eastern branch, above mentioned, in a series of detached elevations, curving E., towards the N., till it meets the S. W. point of an anterior range of the third system, to be hereafter noticed. The range, last described, taken in connexion with the range continued South towards Northford, forms an extended curve, slightly marked, except at its Northern extremity, and parallel to the most Southern section of the third main curve, to which it may be regarded as corresponding. It terminates on the North, nearly W. of the North point of the same section of the third main curve. The Southern portion of the same Eastern range, by the slight flexure Eastward at the commencement of the Eastern branch, may also be regarded as a curve, (parallel and interior to the most Southern curve of the Exterior range,) from the N. W. point of which the Northern curve of the latter range is projected in advancing order. If we regard this Eastern range as a continuation of the Interior range, farther S., in the line of which it is extended, the Southern and Northern

curves of the Exterior range will be in the same relation to the whole Interior range, thus formed, as the two anterior ridges, subordinate to the Western Anterior range, in the preceding system, to their main range; the connecting links uniting them with it, also corresponding to the links uniting the latter to their main range.

The Trap of the different members of the Exterior range is generally fine-grained and rather small fragmentary, or sub-amygdaloidal, and is often very ferruginous, particularly in the Northern curve of the Western section of the range, the surface of the ledges being there often highly rusted, like the surface of Trap ledges freshly exposed by quarrying. At the S. point of the first considerable elevation in the same Northern curve, occurs a variety of fine-grained Trap, divided by vertical cleavages, into thin tile-like, very even fragments.

(E. III.) The *Third Main Curve*, as has already been observed in the general remarks on the Trap system, extends from the South point of Paug Mountain, W. of the West front of the Northern curve of the preceding main range (E. II.,) to a point near the W. bank of the Connecticut, near the line of Wethersfield and Middletown. It is included, however, within the main Eastern line of elevation, only to the N. point of Lamentation Mountain, beyond which it presents a series of ridges of comparatively small elevation. From its S. point, it extends nearly North, in the high Trap range, East of Wallingford and Meriden, to the N. point of the most elevated summit of the range, called Middletown Mountain, or Higby's Hill. It then advances abruptly West, to Lamentation Mountain, at a point E. by N. of the S. point of the fourth main curve, at the Hanging Hills. From that point, it is continued N. N. E. in the high ridge of Lamentation Mountain, and farther North, in a low ridge, in advancing order, extending in the same N. N. E. direction, nearly to the Mattabesick. It then bends abruptly E., in which direction it is continued to its N. Eastern termination, in a series of low curvilinear ridges, generally more strongly marked in their outline, than the higher ridges in the Southern

part of the range. The high range, E. of Wallingford and Meriden, presents a series of ridges, with a curvature more strongly marked towards the S., and slightly so towards the N.; separated from each other by transverse depressions or valleys, more deeply intersecting the range towards the S. The range near its middle point is crossed by a valley, cleft quite to its base, at the road from Wallingford to Middletown. This valley crosses the range nearly directly East and West, with a slight deviation to the South, the ridge North of it, succeeding that South, in very slightly receding order. This valley may be regarded as dividing the range into two leading subordinate curves, the Southern of which is formed of two still more subordinate sections. The Northern of these succeeds the Southern, in distinctly advancing order, and is separated from it by a narrow valley, crossing the range obliquely N. E. This Northern section presents also three similar subdivisions, succeeding each other, in continued, but very slightly advancing order. The range, throughout its whole extent, presents a high mural front to the West, with generally a steep declivity to the East, but with occasional lower mural faces in the latter direction. Beginning at the S. point, the different sections of the range may be separately considered.

1. The First Section (Paug Mountain,) commences at a point nearly opposite the middle of the West front of the Northern curve of Toket Mountain (E. II,) and extends North, rising in a high mural front directly from the East side of Paug (Pistipaug) Pond. It meets the S. E. point of the second section, at the North end of the pond, and is separated from it only by a narrow pass, opening N. Easterly. It then curves around rather abruptly to the E. N. E., in which direction it is continued to the West side of the Middletown Turnpike, terminating in a low detached elevation, adjoining that road on the West. This section thus presents a strongly marked curvature, corresponding nearly in its range to the Northern curve of the preceding main range (E. II.) It might thus be regarded as an appendage of the preceding system, did not its

immediate connexion with the main line of elevation of the present (third) system, as well as its obviously disturbing effect on the ranges of the preceding system, clearly justify the arrangement here adopted. This section presents along its Western front, as far as the detached point at its N. E. termination, the common crystalline Trap, occasionally breaking in large blocks, and along its Eastern declivity, particularly after its bend East, a porous fragmentary amygdaloid. The N. E. part of its curve is of less elevation than that part of it extended Northward in the direct line of the main range, and with a flat tabular summit, as in the two Southern main ranges.

2. The Second Section includes all the remaining part of the Southern half of the present range, from the pass at Pang Pond, to that at the Wallingford and Middletown road, already noticed. It is formed of three subordinate elevations, separated only by depressions on the summit of the range. These elevations succeed each other in slightly advancing order, the Northern point of each of the two Southern passing behind the South point of that next North; each of them thus presenting a slight curvature, corresponding to that of the whole section. The curvature in this, as well as in the other sections of the range, is most distinctly marked, when seen posteriorly. The Southern and Northern ridges of the present section offer a very even outline; the middle, however, presents, on its summit, three short distinct elevations, giving it a very peculiar appearance, even when seen from the remotest distances.* The rock of this summit is a very coarse-grained decomposable Trap, in large square blocks, not a little resembling a sienite. In front of the more Northern ridge, a large column of Trap stands, quite detached, in advance of the mural front of the ridge, visible, as such, however, only from a point nearly in the line of the front of the mountain.

3. The Third Section (first in the Northern half of the

* From this circumstance, it might not inappropriately be called Tremont.

range,) extends from the central pass (at the Middletown road,) to a higher depression, crossing the range N. Easterly, (as in those connected with the Southern half of the range,) at the Meriden and Middletown Turnpike. This section consists of a long ridge of nearly uniform elevation, and of greater length than any other section of the range, with a distinctly marked curvature, particularly at its Southern extremity. It there advances quite abruptly on the North side of the central pass, to a point rather farther West than the West front of the range farther South, when it extends North, receding abruptly near its Northern termination, and thus forming a basin occupied by Black Pond. It recedes, at its North point, behind the Fourth section, running out in a low point, North of the Meriden Turnpike. It is bordered on the East by an uninterrupted valley, distinctly exhibiting its curvature.

4. The Fourth Section extends from the pass at Black Pond, to the North point of the present range, succeeding the former section in slightly advancing order. This forms the highest part of the present range, and next to Mt. Tom and the Hanging Hills, the highest point in the Trap System of the larger Secondary formation. It presents, on its summit, two distinct elevations, with a recession between them, indicating a small degree of curvature. Of these, the Northern is the most elevated, and also terminates very abruptly towards the North. On the Eastern declivity of this ridge, extends a parallel subordinate ridge, commencing slightly in advance of the North point of the preceding section, and extending nearly a mile farther North, than the high front ridge just described. In its detached portion, towards the North, it is comparatively of little elevation, and is crossed, near its Northern termination, by a small brook, precipitated over it in a cascade resembling the falls of the Passaic, in miniature.

The main Eastern line of elevation advances very abruptly, from the North point of the high front ridge of Middletown Mountain, to the range of Lamentation Mountain (5,) which is separated from the preceding range by a wide valley, open-

ing N. N. E. This latter range (5) consists of two distinct ridges, succeeding each other in strongly marked advancing order, the N. point of the Southern extending some distance behind the Northern, and separated by a valley, on the summit of the range. The Southern is shorter, and presents a comparatively wide mural front to the South, while the Northern forms a long ridge, with its mural front to the West, terminating in a bold point towards the South, and running out towards the North, in low swells of amygdaloid, overlaid on the East by the shale of that portion of the Secondary. The direction of this range is more N. Easterly than that of the preceding range, from the recession of its N. point from the main line of elevation, in the direction of the Northern limb of the present main curve. The remaining portion of the present main range, as already observed, is withdrawn from the main line of elevation, and is composed of a series of comparatively low ridges. These have such intimate relations with the posterior ranges of the present system, that they will be most distinctly presented in connexion with the latter.

The Posterior ranges may be arranged in two sections, one of which may be considered as an appendage of the more strongly curved ridge of Paug Mountain, and the other as posterior to the remaining portion of the main range.

(P. 1.) The First Section forms a remarkable group of small, but usually very strongly curved ridges, occupying the interval between the N. E. point of Paug Mountain and the N. E. point of the Toket range, at Bluff Head, and immediately adjoining, on the East, the valley separating the Secondary from the Primary. The arrangement of this group indicates its connexion with the third system, rather than the second; its curves presenting their convexity to the West and North-West, rather than to the N. E. and East, as they should if connected with the latter. Their arrangement, however, corresponds with the curvature of Paug Mountain, rather than with the regular curvature of the entire third main range, as will be perceived by reference to the accompanying map. This group

presents two distinct ranges, an Anterior (Western,) and a Posterior (Eastern,) which apparently coalesce at their Northern extremity. Of these, the posterior presents the most strongly marked curvature in its ridges, particularly towards the South, where they nearly form circles, enclosing central crater-like hollows. This range is chiefly composed of amygdaloid, particularly the light blue felspathic variety, noticed in connexion with the Northern curve of the Interior anterior range of the preceding system, which, as in that instance, is usually highly ferruginous. The Western range is less strongly marked in its curves than the Eastern, but still strikingly so, in comparison with most other Trap ranges. Its Southern extremity forms a low swell of the light blue amygdaloid, just noticed, similar to that of the anterior range of Toket Mountain, near which it extends. The greater part of the range farther North consists of crystalline Trap, in larger blocks, and small fragmentary sub-amygdaloidal Trap, which last is also continued into the Northern more anterior portion of the Eastern range. The two ranges are thus in a relation to each other, in regard to their composition, similar to that of the anterior and posterior portions of most of the larger Trap ranges, as explained in a cross section of the Toket range. Each of these ranges is divided into two sections, by a cross depression on the summit of the general elevation of the group; the Northern and Southern sections in both respectively corresponding. Each of the sections, in the Eastern range, consists of two well-marked curves, but in the Western range, the curvature of the subordinate members of the two sections is less strongly marked, each of the sections forming but one distinct curve. At the N. E. point of its Southern curve, the Western range presents two lines of elevation, so arranged as to enclose an oval hollow, in a manner similar to that noticed in the N. E. part of the first anterior range of (E. I.) The arrangement of the different ridges in this group is apparently more complex than in any other part of the general Trap system. A more detailed view of this arrangement is given

in the map accompanying this report. The Trap of this group usually traverses a coarse conglomerate, formed of angular fragments of Primary rocks, generally from the adjoining Primary ranges (B 3—2,) which in the vicinity of the Trap, resembles the indurated variety, noticed in connexion with the two extremities of the Northern posterior range of (E. II.)

(P. 2.) The Second (Northern) Section forms a long narrow range, similar to the corresponding portion of the main range, namely, that from the S. point of the second section of the latter, Northwards. It presents two distinct curves, or subordinate ranges, of which the Southern is very strongly marked, resembling, in that respect, the two first main curves (E. I—II.) The Northern is more like the main range, in its outline. The Southern of these curves, or ranges, commences on the West side of the valley, separating the Secondary from the Primary, opposite the point where the latter makes a considerable recession to the East, S. of Durham village, and at a point N. N. E. from the N. E. point of the group (P. 1.) It at first forms a strongly marked curve, convex to the South, fronting the group (P. 1,) and surrounding the basin of the Aramamit (Durham meadows,) on the South. It extends thus West to the Middletown Turnpike, where it appears as a highly inclined dike, overlaid by sandstone. It then advances S. W. to a bold point, West of the Turnpike, and N. E. from the N. E. point of the range of Paug Mt., where it bends abruptly North. In front of this Southern part of the range, a parallel small range of Trap (t,) chiefly amygdaloidal, but with a ledge of crystalline Trap at its S. E. point, extends nearly E.—W. along the summit of a high ridge, with an obvious curve, convex to the South, thus indicating its connexion with the present posterior range, and terminates, on the West, nearly East of the N. E. point of Paug Mt. The present range, after its bend North, is continued in a series of ridges, more or less interrupted, in advancing order, towards the South, and in receding order, towards the North, in a general Northern direc-

tion, parallel to the main range, to a small brook, S. W. of Middlefield meeting-house, soon after which it curves rather abruptly East to the Middlefield Falls, on the Aramamit, and again bearing a short distance N. along the course of the stream, terminates against the West side of a high ridge of sandstone. The range, after its bend Northward, is usually of little elevation, and is occasionally subordinate to higher ridges of sandstone. In some parts of its course, too, it is much concealed by diluvium. The Trap of this Southern curve is usually sub-amygdaloidal, and more or less vesicular. Datholite is found in its cavities, particularly at Middlefield Falls. In some instances, as at the passage of the small stream, S. W. of Middlefield meeting-house, it is apparently stratified, being divided into layers, by cleavages parallel to the underlying sandstone. In the S. part of the range, particularly adjoining the Middletown Turnpike, a fine-grained, small fragmentary, very ferruginous Trap predominates. This Southern range may be considered as representing the proper curvature of the Third System more perfectly than the main range, particularly on the South. It terminates, on the North, at a point nearly East of the S. point of Middletown Mt., at Black Pond.

The Northern curve, or range, commences in advance of the N. E. point of the preceding, with which, however, it is connected by a short ridge of Trap, bearing N. E. from a point W. of the Falls, to near its Southern extremity. The range first bears N. Westerly to the Meriden Turnpike, and then more directly North, in a long very even ridge, East of Westfield village, to the S. side of the valley of the Mattabesick. Throughout this whole distance, it is but slightly interrupted, and forms a broad ridge with a line of ledges of crystalline Trap, along its W. front, and a long slope of porous amygdaloid towards the East. In the valley of the Mattabesick, South of that stream, is a small appended ridge of Trap, in advancing order, and more strongly curved, marking apparently the termination of the present range. North of the Matta-

besick, rises a high broad rounded ridge, with a range of Trap extending along its Southern and Western sides, and running out in a low swell at its N. W. point. The summit and N. E. declivity of the ridge are apparently occupied by sandstone. The Trap of this ridge thus forms a strongly marked curve, fronting on the South, the curvature at the N. point of the range S. of the Mattabesick, the valley of that stream crossing the range transversely, nearly directly East and West. This curve, appended to the Northern posterior range, approaches, on the West, particularly towards its N. point, a range of Trap, farther West, next to be described.

(P. 3.) This range might be regarded as a continuation of the posterior ridge of Middletown Mt., already noticed as extending some distance farther N. than the main front ridge of the same. After a considerable interval, receding across a valley, opening N. W., the range, now under consideration, commences in the West front of a ridge of sandstone, and soon advancing N. W., is continued N. N. E. in a series of low detached ridges, to the Mattabesick. The Trap in this part of the range, is chiefly amygdaloidal. North of the Mattabesick, the range occupies a wide ridge, presenting two lines of Trap ledges, an Eastern and a Western, coalescing towards its N. point, opposite the N. point of the preceding range, from which it is there separated only by the valley of a small stream from the North. The Western (anterior) line is composed of a more crystalline Trap; the Eastern, of amygdaloid. Farther N. this range is continued N. N. E. in a series of lower and more detached elevations, then passes along the Eastern base of a high diluvial covered ridge, where it is partly concealed, and finally terminates in a line of low swells of amygdaloid, soon uniting with the main range of the present system, near the middle point of the Northern limb of its curvature.

Proceeding farther West, we meet another range of Trap (P. 4,) nearly parallel to the one last mentioned, and still more nearly so to the Northern longer ridge of Lamentation Mt.

This commences, in a short, but strongly marked curve, a short distance North of the N. point of the high front ridge of Middletown Mt., and West, in advance, of the posterior ridge of that mountain. It is, however, separated from these ridges, by a deep valley, and an interposed band of shale. It then extends N. N. E. in a long narrow uniform ridge, usually of little elevation, parallel to Lamentation Mt. on the East, to a point not far North of the Farmington and Middletown Turnpike. In its Northern portion, N. of the termination of Lamentation Mt., it is of greater elevation and general magnitude, as if replacing the latter. Although continued in the direct line of the front ridge of Middletown Mt., this range should rather be considered as corresponding posteriorly to the range of Lamentation Mt.

Along the West side of the Northern termination of this range, extends a short advanced curve of amygdaloidal hummocks, at a point N. E. of the N. point of Lamentation Mt. About half way between these two points, on the West side of a high diluvial covered ridge of shale, interposed between (P. 4) and the N. point of Lamentation Mt., extends another short range (t) of fragmentary and amygdaloidal Trap, forming obviously a connecting link between the range of Lamentation Mt. and the amygdaloid at the N. point of (P. 4.) This range (t) appears at first in a ravine, near the base of the ridge of shale, just noticed, on the Western side of which the shale dips Westward, while on the Eastern side it retains its usual Eastern dip. In the middle of this ravine, extends a long irregular fissure, at the point where the strata are disturbed, bordered throughout by a band of altered shale, generally very dark coloured, and small fragmentary, with chloritic glazings. At the N. end of the ravine, the Trap begins to appear in detached points and seams, and at last breaks out in a small hummock, whence it extends N. Easterly, in an undulating course, along the W. side and across a part of the N. point of the ridge, in a direction towards the amygdaloid at the N. W. point of (P. 4.) This range (t) appears, in a part of its course,

distinctly as a nearly vertical dike, bordered by indurated shale on the East, but exposed on the West, in the manner already noticed in that part of (A. 3—E. I) S. E. of Prospect Hill (East Haven.)

We may now pursue the course of the main range of the present system, N. of the point where it recedes from the main Eastern line of elevation. The first of the subordinate ranges in this part of its course (1,) commences, in advancing order, at a point N. W. of the N. point of Lamentation Mt., and at a short distance East of the Hartford Middle Turnpike. It first recedes N. E. in a series of more detached elevations, and then is continued N. N. E. (East of Worthington village,) in a long nearly uniform ridge, with a line of Trap ledges along its West front, and a long slope of amygdaloid towards the East, nearly to the Mattabesick. It then bends around abruptly in a very distinctly marked curve, terminating in a point towards the S. S. W. At its termination, it is chiefly composed of a very small fragmentary amygdaloid, decomposing into a gravel, much used in the vicinity for roads and walks. The Northern part of this range is bordered in front by a number of parallel terraces of shale, conforming to it, in direction; the shale, at its N. E. point, dipping S. W. towards the front of the range. As it bends around to the South, it approaches very near the West front of the next succeeding curve, being separated from it only by a depression on the summit of the ridge.

The second curve (2) commences at a point, nearly half a mile S. of the termination of the preceding, and nearly in the line of the range (P. 4 ;) an interval of about the same distance being interposed, in which the line of Trap is apparently discontinued. This second curve first extends N. N. E. in a straight narrow ridge, till it meets the termination of the preceding, when it bends around very abruptly, terminating in a steep front on the West bank of the Mattabesick. The Southern part of this ridge is chiefly composed of the friable amygdaloid, noticed on the back of the preceding, at its N. E. extremity.

East of the Mattabesick, the main range is continued, in a direction nearly East, by two strongly curved ridges (3) of moderate length; the first of which bears more E. N. E.; the second more directly East. They are separated from each other by a valley opening South. The first commences on the East side of the Mattabesick, opposite the termination of the preceding, and forms a ridge of very uniform outline, curving South, at its termination, along the West side of the valley last noticed. Amygdaloid abounds in this ridge, particularly on its Southern declivity, and in some places is so iron-shot, as to have been taken for an iron ore. The second of these ridges commences, on the East side of the separating valley, at a point farther South than the termination of the first ridge, forming there a group of amygdaloidal hummocks, crossed by a small stream, in a manner similar to that noticed at the N. point of the posterior ridge of Middletown Mountain. This ridge first extends N. N. E. along the East side of the valley, above noticed, and then bends around E. S. E., (forming a more strongly marked curve than the preceding,) till it terminates in a low point about half a mile N. W. of the point, where the range (P. 3,) continued from the posterior ridge of Middletown Mountain, unites with the main curve. The present ridge projects South, at its commencement, like the ridge (2) immediately West of the Mattabesick, though in a less degree, and is in a relation to the Western more advanced front of (P. 3,) North of that stream, similar to that of (2) to the range (P. 4) posterior to Lamentation Mountain. The two ridges, East of the Mattabesick, are bordered in front by parallel ridges of shale, like the first ridge of this Northern part of the main curve, and farther North, by a valley extending N. E. from Berlin towards Wethersfield.

The main range, after its union with the range (P. 3,) extends nearly directly East, forming a series of low ridges (4,) on an elevated base, rapidly descending towards its termination, and terminating in a low dike-like point, in the plain W. of the Connecticut. The Northern extremity of (P. 3) is con-

tinued in the line of the main range, in a low ridge, bending East, and terminating in a higher abrupt point, after a course of about half a mile. This ridge is bordered North by a parallel ridge of shale, continued farther East, and is succeeded, in nearly the same line, by a lower ridge of shale, parallel to the main range, farther East. The latter is continued, in a similar low uniform ridge, commencing at a point S. E. of the Eastern bend of the preceding ridge, and extending some distance farther East, when a valley crosses the range directly N.—S. Farther East, the range is continued in the same line, in a series of more detached elevations, particularly towards its Eastern extremity, where it curves distinctly S. E. Near its termination it crosses a small stream (Division Brook,) where it appears distinctly as a dike, bordered by indurated sandstone. This range is bordered towards its Eastern extremity, by a large accumulation of diluvial sand and gravel, on the North, and on the South, by an extensive and elevated sand-plain, N. of Middletown (Upper Houses.) In a line, farther South than the East point of the present range, conformably to its curvature S. E. at that point, a remarkable ridge of very coarse conglomerate extends, in a line nearly West—East, from near the Connecticut, to the Western border of the Eastern Primary, being separated from the latter only by a deep narrow valley, opening South. This ridge apparently marks the continuation of the elevating force of the third main curve, quite to the frontier of the Primary.

The curve formed by the range (P. 3,) continued from the N. point of the Southern range of the present main curve, at Middletown Mountain, and the Eastern portion of the main curve, last described, may be considered as forming, with that Southern main range, a distinct and uniform curve, co-extensive with the Third System, whilst the curve formed by Lamentation Mountain, and the subordinate ranges of the main curve to the East point of the second ridge, East of the Mattabesick, may be regarded as another distinct appended curve, anterior to the former, towards the North. The range (P. 4,)

posterior to Lamentation Mountain, forms, as it were, a connecting link between the former curve, at the N. point of its most elevated portion, and the Northern part of the latter. The large posterior curve (P. 2 S.,) extending from the S. part of Durham to Middlefield Falls, presents, as already observed, the proper curvature of the Third System, more completely than the main range. The range (P. 2 N.,) commencing near its North point, and approaching the range (P. 3,) North of the Mattabesick, connects it in nearly the same manner as in the last instance, with the former of the two curves, above noticed. The short detached range of Trap (‡,) interposed between the N. point of Lamentation Mountain and the N. point of (P. 4,) may be considered as a connecting link between those two ranges, uniting them in the same manner that the S. part of (P. 3) connects the main range at the N. point of Middletown Mountain with the N. point of (P. 2 N.,) North of the Mattabesick. The range (P. 3) is, however, distinctly continued by the N. point of (P. 2 N.) till it unites with the main curve at the West point of (4.) The range (‡) may, in like manner, be considered as continued by the N. point of (P. 4,) in the line of amygdaloidal hummocks in front of the latter, to the South point of the ridge (2,) in the main curve, West of the Mattabesick. This is rendered more probable by the amygdaloidal character of (2,) at its S. point, resembling that of (‡,) while the range (P. 4) is composed of a variety of Trap, more compact and less fragmentary. Thus considered, the resemblance of (P. 4) to (P. 2 N.,) in its arrangement, will be still more exact and obvious. This inosculation of different curves or ranges, is similar to that already noticed in the Exterior Anterior ranges of the two preceding systems.—The curve of the Primary dike, extending from the point East of Quonipaug Pond to Middle Haddam, corresponds to the curve of the present system; commencing about E. S. E. from the South point of the main range of the latter, but terminating nearly East of the North point of its posterior curve (P. 2 S.,) and also about E. S. E. of the S. point of the fourth main range.

The Anterior lateral ranges of the present system are proportionately less developed than the posterior ranges. Two distinct ranges may be here noticed, as in the preceding system. Of these, the Interior range is much the most extensive; being, indeed, nearly co-extensive with that part of the main range, included within the limits of the main Eastern line of elevation. This may be divided into three sections, corresponding to the two sections of the range East of Wallingford and Meriden, and to that of Lamentation Mountain. The Southern of these sections, corresponding to the section of the former range, S. of its central pass, is higher proportionally, and more remote from the main range, and is, indeed, in the line of the Exterior Anterior range of the preceding system, continued Northward. The two more Northern sections form a series of amygdaloidal ridges, closely parallel to the main range, and appearing as it were, appended terraces in front of the latter, from which they are, however, usually separated by an intervening valley, occupied by a band of shale, with beds of fine-grained sandstone, and occasionally of limestone. The Exterior range forms a well marked curve, composed of a series of dikes, slightly elevated above the including sandstone, and extending along the East side of the Quinipiack valley, through Wallingford village.

(A. 1.) The Interior range may be first noticed. The Southern section commences at a point about W. N. W. of the S. point of the second subordinate range of the Southern section of the main range, namely, that rising North of Paug Pond, and at a short distance South of the point where it meets the N. E. point of the Exterior Anterior range of the preceding system, consequently succeeding the latter in receding order. It is bordered on the South by a transverse valley, opening W. to Muddy Brook, and is flanked on each side, at its S. point, by abrupt ridges or outworks of sandstone. The present range commences in a very remarkable circle of small elevations or hummocks of a fine-grained fragmentary Trap, inclosing a circular crater-like hollow, opening South. This is apparently

formed by two distinct lines of elevations, rising rapidly to the summit of a high ridge, more nearly approaching the main range in elevation, than any part of the Interior range, farther North. These two lines of elevations coalesce at the S. point of this summit, where they also unite with the N. E. point of the range (A. 2) of the preceding system. The present range becomes lower towards the North, and at the same time wider and more broken, the two lines of elevations being there more distinctly separated. The range terminates, on the North, at a low point, about W. S. W. from the central pass of the main range. The anterior line of elevations there apparently surrounds the interior, and extending some distance South, along the East side of the range, terminates in a dike, in the North point of a sandstone ridge, bordering the higher part of the range on the East. The Trap of this range resembles that of the Exterior range (A. 2) of the preceding system, being generally fine-grained and small fragmentary, though the common crystalline variety is not unfrequent in the higher part of the range. This range is separated from the main range on the E. by an extensive swamp basin, from which Muddy Brook issues, and flows around its Northern extremity. An interesting locality may here be noticed, apparently indicating the occurrence of a ridge of amygdaloid, similar to that of the two Northern sections of the present Interior range, in front of the main range, at Paug Mountain. On the East side of the summit of a wide ridge of sandstone, at a point West of the pass, North of Paug Pond, are two or three points of a limestone, similar to that of Elliott's Quarry, already noticed, just emerging from the diluvium, and formerly quarried for lime; apparently resting on a very porous amygdaloid, the cavities of which are chiefly occupied by calcareous spar, and this latter on an indurated, very ferruginous sandstone. This range of amygdaloid with limestone appears to terminate a short distance farther North, nearly opposite the ridge of sandstone, flanking the South point of the preceding range on the East. This latter range might be considered as succeeding it in advancing order, the two form-

ing a curve corresponding to the entire extent of the Southern section of the main range.

The [illegible] section of the Interior range, fronting the Northern section of the main range. East of Meriden, commences at the S. E. point of a high round ridge, the Western part of which is composed of sandstone, rising about W. N. W. from the eastern pass in the main range, and terminates nearly West of the North point of Middletown Mountain, at a comparatively [illegible]. Like the corresponding part of the main range, it consists of two sub-divisions, separated by a valley, through which a stream flows West from Black Pond. The [illegible] corresponding to the sub-division of the main range, from the eastern pass to the Meriden and Middletown [illegible] road, throughout the greater part of its course, a [illegible] chiefly composed of a very vesicular amygdaloid, with [illegible] parts of a fine-grained small fragmentary [illegible], and bordered in front by a rather [illegible] of sandstone. It is separated, on the East, from the main range, by a long narrow valley, opening South in the greater part of its distance. This ridge continues [illegible] in its outline, to the main range East, and has [illegible] a distinct curvature, towards the South. At its North point is a small appended, more strongly marked ridge, in advancing order, connecting it with the next sub-division towards the North. This latter, corresponding to the small range of Middletown Mountain, presents, like that range, two subordinate members. Of these, the Southern consists of a broad rounded ridge, chiefly covered with dilu[illegible] but in which the Trap is exposed at its S. W. and N. E. points, chiefly composed of porous amygdaloid. The Northern presents two parallel divisions, of which the Eastern is the line of the Southern subordinate member, and like it consists of a porous amygdaloid. It is of less extent in its Southern part, opposite the Western division, but towards its North end, forms a broad but low rounded ridge, terminating West of the North point of the high front ridge of Mid-

dletown Mountain, and about S. S. W. of the South point of the range (P. 4,) posterior to Lamentation Mountain. The Western division consists of four parallel short low ridges, fronting the South half of the Eastern, and succeeding each other in advancing order, towards the S. E. point of the range of Lamentation Mountain. These ridges consist of a more crystalline Trap, which in the two middle, particularly, breaks in larger fragments. This Western division may be considered as a link leading to the range of Lamentation Mountain, next succeeding. Limestone has been found on the back of the present subdivision, nearly opposite the middle point of the main range.

The Northern section of the Interior range, corresponding to the main range of Lamentation Mountain, consists, like the latter, of two subordinate members, closely parallel and conforming, in outline, to the two sections of the main range. The Southern of these divisions forms a short, very strongly marked curve, extending along the front of a lower terrace of the mountain, and surrounding the main summit on the S. W. and South. The Northern division commences at a point nearly South of the South point of the Northern section of Lamentation Mountain, whence it bears first W. S. W. and then bends around abruptly North, forming a lower ridge or terrace parallel to the main range, from which it is separated by a valley or depression, occupied by shale, containing beds of very fine-grained sandstone, and traces of a sub-bituminous limestone. Towards its Northern extremity, the range becomes more irregular, terminating in an appended more strongly marked curve, crossing the Middle Hartford Turnpike just N. of the gate, South of Berlin, and at a point some distance S. W. of the North point of the main range, corresponding. This ridge, in its Southern part, consists chiefly of a very porous amygdaloid, in which, at its South point, is an old excavation for copper. In its Northern part, it is partly composed of a peculiar Trap conglomerate, or rather brecciated amygdaloid, distinctly parallel or stratified in its arrangement.

This occurs on the West side of the ridge at the gate, and in a low parallel ridge, posterior to the appended curve at its Northern extremity. The front of that curve presents a higher range of sub-amygdaloidal Trap, breaking in large irregular blocks, and in part nearly filled with large dark green agates, some of which are of extraordinary magnitude.

The Interior Anterior range, now described, is thus from the central pass in the main range, East of Wallingford, closely approximated and very exactly conformable to the main range. The ridge, at the limestone locality, West of the Paug Pond pass, may be regarded as a continuation of the same appended range, interrupted or absorbed, East of the Southern Section of this Interior range, by the greater elevating force of the latter, which, while it conforms in its direction to the corresponding part of the main range, is yet properly a continuation of the Exterior Anterior range (A. 2) of the preceding system. The Northern section of the present Interior range is, at its N. point, nearly in the line of the subordinate ridge (1,) in the Northern lower part of the main range, from which it is separated by an interval of nearly a mile in a N. N. E. direction.

(A. 2.) The Exterior range extends from the South point of the ridge, on which the village of Wallingford is situated, to a point not far N. N. E. of Hill's Factory, and about a mile N. E. of that village. It consists entirely of a series of more or less detached dikes, succeeding each other in the same order as the different elevations of the larger Trap ridges, and forming, in the whole, a well marked curvilinear range. At its commencement, it forms a short, very strongly marked curve, consisting of a series of small dikes, composed partly of a very fine-grained, small fragmentary Trap, and partly of a Trap conglomerate, traversed by threads of a similar fine-grained Trap, sometimes nearly resembling the wacke on the sides of the dikes connected with the Primary. These dikes are bordered by an indurated sandstone, partly coloured light green, with fragments of red felspar disseminated.

In passing through the village of Wallingford, the range is concealed by diluvium, but has been exposed by excavation. It re-appears near the N. E. part of the village, and farther N. in a sandstone ridge, East of the road from Wallingford to the pass at Black Pond, whence it bends abruptly East to Hill's Factory, where it crosses a stream (Wharton's Brook,) in a remarkable dike, bordered by green indurated sandstone. It appears again, adjoining the brook, farther North, in advancing order, in a dike of similar character. The course of the range, at these two localities, is nearly East (E. N. E.) The dikes in this range, particularly in its Northern part, are bordered by a soft light green wacke, which sometimes almost entirely forms the smaller branches. This range commences at a point, about East of the N. E. point of the Mount Carmel range (Western line of elevation,) and about West of the S.W. point of the Northern curve of the Exterior Anterior range of the preceding System, and terminates opposite the West front of the Southern section of the Interior Anterior range of the present system. It might thus be considered as a link connecting the second and third Eastern systems, like the Exterior range of the preceding system, but more advanced than the latter, and also as intermediate between the Eastern and Western systems, but within the sphere of elevation of the former; that extending West to the valley of the Quinipiack.

These are the only ranges or localities of Trap, observed by me, properly anterior to the third Eastern system. Others of small extent may exist in the country between the main range of that system on the East, and the Quinipiack valley and line of the Rail Road on the West. The country is there occupied by ridges of sandstone, conforming in their arrangement to that of the main range, last mentioned.

(E. IV.) The *Fourth Main Curve* is much the most extensive of all those in the Eastern line of elevation; the chord of its curvature exceeding 50 miles in length.* It commences at a

* About 55 miles, as measured on Hale's Map of New England, from the S. W. point of the Hanging Hills, to the East point of the Mount Holyoke range, at the ponds West of Belchertown (Mass.)

low point, West of the S. point of Lamentation Mountain, and rising suddenly into the high abrupt range of the Hanging Hills, advances W. a short distance, to the S. W. and highest point of that range, and then bends abruptly N., in which direction it proceeds, in advancing order, to Cook's Gap, S. of Farmington. It then bears more N. N. Easterly, in a long continuous range, of variable outline, to the Connecticut, at the N. point of Mount Tom, when it bends rather abruptly E., in the range of Mount Holyoke, and continues in that direction, to within a short distance of the Eastern Primary, West of Belchertown. This range is thus strongly curved at its two extremities, and consists apparently of portions of three larger curves, united by more abrupt flexures, or portions of smaller curves. The bend at its S. W. and N. W. points, though sudden, is yet obviously not at a sharp angle. The gradual curvature at these points is more particularly obvious, when viewed posteriorly. The Northern limb of this curve is more extended than the Southern; no obstacle being opposed to its progress, till it approaches the Western border of the Eastern Primary, while, on the contrary, the progress of the Southern limb is soon obstructed by the range of Lamentation Mountain, in the main curve of the Third System. The main Eastern line of elevation is continued from the last mentioned range, in the third system, to the S. E. point of the present main curve, and thence along the course of the latter, to its N. E. termination. A singular progress may here be pointed out in the succession of the different main curves of the Eastern line of elevation. The second commences N. E. of the termination of the first, the two curves merely approaching, without disturbance. The third commences West of the most Northern point of the second, and is apparently interrupted in its curve, by the latter, which, at the same time, is included, to its termination, within the main line of elevation. The fourth commences opposite the West front of the third, at a considerable distance South of the North point of the latter, which is thus withdrawn, in its more Northern portion, from the main line of elevation.

The present main range may be divided into two leading sections, a Southern (1) and a Northern (2,) differing from each other, in several important particulars. The Southern section includes that part of the range, S. of the South point of Talcott Mt.; the Northern, that part from Talcott Mt. inclusive, to its N. E. extremity. The Southern section presents a series of shorter, more detached and abrupt elevations, generally succeeding each other in advancing order, and separated by deep cross valleys, or passes, usually directed N. Easterly, corresponding to the above order of succession. It is accompanied, throughout, by a closely parallel anterior range of amygdaloid, separated from the main range by an interposed band of shale with limestone, in the same manner as has already been noticed in the preceding main range. It is also accompanied by a very extensive series of posterior ranges, more numerous and more largely developed than in any other part of the general Trap system. The Northern section, on the contrary, presents, particularly in its Southern portion, where directed N. N. E., a series of long, more uniform, and less detached ridges, separated usually by more transverse depressions, and only in three instances by deep passes, namely, at the passage of Farmington, Westfield and Connecticut rivers. In its N. E. part, East of the Connecticut, its summit is more broken; still it forms there an uninterrupted range. The anterior amygdaloidal ridge has been observed by me, only in one point, in front of this section, namely, between the two copper mines in Granby; but facts, which will be afterwards noticed, apparently indicate, that this amygdaloidal appendage is, in other parts of the section, immediately attached to the main range, forming a slightly lower terrace in front. This Northern section is also without the extensive system of posterior ranges, attached to the Southern section, only one posterior ridge having been noticed by me, detached from the main line of elevation, and that forming a closely parallel range, at a short distance from the main range.

The Southern Section (1) may be considered as divided into

two subordinate members, by a remarkable pass (Cook's Gap,) crossing the range in a direction nearly E. S. E., like the central pass in the preceding main range. The range there commences on the North, in receding order, behind the N. E. point of that portion of it S. of the pass, and the order of succession, which farther S. is strongly advancing, is there changed to a slightly receding continued order, which prevails generally throughout the remaining part of the range; a slight advance occurring only at the S. points of the more considerable elevations. A depression, marked by the course of the N. branch of the Mattabesick, may be traced E. S. Easterly, across the country, from this pass, to the N. W. point of the third main curve, on the N. side of which the posterior ranges present an arrangement somewhat corresponding to that of the main range. The two most posterior ranges, which may be considered as based on the N. limb of the third main curve, commence on the South, at a point nearly East of this pass. This might be considered as the proper commencement of the fourth main curve, in the same manner as the third main curve may be regarded as commencing at the pass N. of Paug Pond (West of the S. point of the principal posterior curve of that system.) That part of the fourth main range, as above described, S. of Cook's Gap, might be regarded as intermediate between the third and fourth systems, in the same manner as the range of Paug Mt. may be regarded as intermediate between the second and third. For the reasons above given, I prefer, however, to consider the Southern section as extending farther N. to the S. point of Talcott Mt.

The Southern section presents at its S. E. point, a long low range (1,) closely connected with the higher part of the main range, being separated from it only by the narrow pass (or ravine) of Cat-Hole, but extending N. N. E. to a point farther N. than the N. point of Lamentation Mt., not, however, in a direction exactly parallel to the latter range, but more inclined to the West. This range might be considered as posterior to the main range, but from its close connexion with the latter,

may rather be regarded as a continuation of the same line of elevation, curving around far on the East, opposite the Western front of the third main range. It is separated from the latter, by a long valley, through which the line of the Hartford and New Haven Rail Road is extended, the summit of which is at a lower level than that of any similar pass through the Eastern line of elevation, at least S. of Cook's Gap. This valley is occupied by the basin of Beaver Pond, extending S. to a point W. N. W. of the S. point of Lamentation Mt., and opening N. into the basin of the Mattabesick in Berlin. On the East side of this basin, the sandstone of Meriden extends N. along the base of the Anterior range of Lamentation Mt., nearly to the gate (S. of Berlin,) while on its W. side, the shale of Berlin extends farther S., on the back of the range in question. This circumstance apparently indicates this valley as the line of separation between the third and fourth systems. The present range (1) consists of two lines of elevation, separated by a narrow continuous valley, namely, a higher anterior line, extending along the East side of Cat-Hole, commencing farther S., but terminating sooner towards the North, and a lower posterior line, commencing in a group of detached elevations of fragmentary Trap and amygdaloid, S. W. of Beaver Pond, and continued N. in a long nearly uniform ridge, to a point nearly W. of the N. point of Lamentation Mt., where it is succeeded, in advancing order, by a wide short range, consisting of several parallel ridges of Trap, the Eastern the most elevated.

West of the pass of Cat-Hole, the higher part of the fourth main range commences, in a short detached elevation (South Mt.) (2,) separated from the range farther West, by a deep cross valley (the Notch,) opening nearly North. This ridge presents a high mural front to the S. East and South, and also to the West, towards the Notch, and on the North, sends off two lower spurs from its Eastern and Western extremities, indicating a strongly marked curvature. These spurs terminate in low points, about half a mile N. of the main range. They

The Anterior lateral ranges of the present system are proportionately less developed than the posterior ranges. Two distinct ranges may be here noticed, as in the preceding system. Of these, the Interior range is much the most extensive; being, indeed, nearly co-extensive with that part of the main range, included within the limits of the main Eastern line of elevation. This may be divided into three sections, corresponding to the two sections of the range East of Wallingford and Meriden, and to that of Lamentation Mountain. The Southern of these sections, corresponding to the section of the former range, S. of its central pass, is higher proportionally, and more remote from the main range, and is, indeed, in the line of the Exterior Anterior range of the preceding system, continued Northward. The two more Northern sections form a series of amygdaloidal ridges, closely parallel to the main range, and appearing as it were, appended terraces in front of the latter, from which they are, however, usually separated by an intervening valley, occupied by a band of shale, with beds of fine-grained sandstone, and occasionally of limestone. The Exterior range forms a well marked curve, composed of a series of dikes, slightly elevated above the including sandstone, and extending along the East side of the Quinipiack valley, through Wallingford village.

(A. 1.) The Interior range may be first noticed. The Southern section commences at a point about W. N. W. of the S. point of the second subordinate range of the Southern section of the main range, namely, that rising North of Paug Pond, and at a short distance South of the point where it meets the N. E. point of the Exterior Anterior range of the preceding system, consequently succeeding the latter in receding order. It is bordered on the South by a transverse valley, opening W. to Muddy Brook, and is flanked on each side, at its S. point, by abrupt ridges or outworks of sandstone. The present range commences in a very remarkable circle of small elevations or hummocks of a fine-grained fragmentary Trap, inclosing a circular crater-like hollow, opening South. This is apparently

formed by two distinct lines of elevations, rising rapidly to the summit of a high ridge, more nearly approaching the main range in elevation, than any part of the Interior range, farther North. These two lines of elevations coalesce at the S. point of this summit, where they also unite with the N. E. point of the range (A. 2) of the preceding system. The present range becomes lower towards the North, and at the same time wider and more broken, the two lines of elevations being there more distinctly separated. The range terminates, on the North, at a low point, about W. S. W. from the central pass of the main range. The anterior line of elevations there apparently surrounds the interior, and extending some distance South, along the East side of the range, terminates in a dike, in the North point of a sandstone ridge, bordering the higher part of the range on the East. The Trap of this range resembles that of the Exterior range (A. 2) of the preceding system, being generally fine-grained and small fragmentary, though the common crystalline variety is not unfrequent in the higher part of the range. This range is separated from the main range on the E. by an extensive swamp basin, from which Muddy Brook issues, and flows around its Northern extremity. An interesting locality may here be noticed, apparently indicating the occurrence of a ridge of amygdaloid, similar to that of the two Northern sections of the present Interior range, in front of the main range, at Paug Mountain. On the East side of the summit of a wide ridge of sandstone, at a point West of the pass, North of Paug Pond, are two or three points of a limestone, similar to that of Elliott's Quarry, already noticed, just emerging from the diluvium, and formerly quarried for lime; apparently resting on a very porous amygdaloid, the cavities of which are chiefly occupied by calcareous spar, and this latter on an indurated, very ferruginous sandstone. This range of amygdaloid with limestone appears to terminate a short distance farther North, nearly opposite the ridge of sandstone, flanking the South point of the preceding range on the East. This latter range might be considered as succeeding it in advancing order, the two form-

ing a curve corresponding to the entire extent of the Southern section of the main range.

The middle section of the Interior range, fronting the Northern section of the main range, East of Meriden, commences at the S. E. point of a high broad ridge, the Western part of which is occupied by sandstone, rising about W. N. W. from the central pass in the main range, and terminates nearly West of the North point of Middletown Mountain, at a comparatively lower elevation. Like the corresponding part of the main range, it consists of two sub-divisions, separated by a valley, through which a stream flows West from Black Pond. The Southern, corresponding to the sub-division of the main range, from the central pass to the Meriden and Middletown Turnpike, forms, throughout the greater part of its course, a low uniform ridge, chiefly composed of a very vesicular amygdaloid, with occasional points of a fine-grained small fragmentary Trap anteriorly, and bordered in front by a rather higher parallel ridge of sandstone. It is separated, on the East, from the main range, by a long narrow valley, opening South for the greater part of its distance. This ridge conforms very exactly, in its outline, to the main range East, and like that presents a distinct curvature, towards the South. At its North point is a small appended, more strongly marked curve, in advancing order, connecting it with the next subdivision, towards the North. This latter, corresponding to the main range of Middletown Mountain, presents, like that range, two subordinate members. Of these, the Southern consists of a broad rounded ridge, chiefly covered with diluvium, but in which the Trap is exposed at its S. W. and N. W. points, chiefly composed of porous amygdaloid. The Northern presents two parallel divisions, of which the Eastern is in the line of the Southern subordinate member, and like that consists of a porous amygdaloid. It is of less extent in its Southern part, opposite the Western division, but towards its North point, forms a broad but low rounded ridge, terminating West of the North point of the high front ridge of Mid-

dletown Mountain, and about S. S. W. of the South point of the range (P. 4,) posterior to Lamentation Mountain. The Western division consists of four parallel short low ridges, fronting the South half of the Eastern, and succeeding each other in advancing order, towards the S. E. point of the range of Lamentation Mountain. These ridges consist of a more crystalline Trap, which in the two middle, particularly, breaks in larger fragments. This Western division may be considered as a link leading to the range of Lamentation Mountain, next succeeding. Limestone has been found on the back of the present subdivision, nearly opposite the middle point of the main range.

The Northern section of the Interior range, corresponding to the main range of Lamentation Mountain, consists, like the latter, of two subordinate members, closely parallel and conforming, in outline, to the two sections of the main range. The Southern of these divisions forms a short, very strongly marked curve, extending along the front of a lower terrace of the mountain, and surrounding the main summit on the S. W. and South. The Northern division commences at a point nearly South of the South point of the Northern section of Lamentation Mountain, whence it bears first W. S. W. and then bends around abruptly North, forming a lower ridge or terrace parallel to the main range, from which it is separated by a valley or depression, occupied by shale, containing beds of very fine-grained sandstone, and traces of a sub-bituminous limestone. Towards its Northern extremity, the range becomes more irregular, terminating in an appended more strongly marked curve, crossing the Middle Hartford Turnpike just N. of the gate, South of Berlin, and at a point some distance S. W. of the North point of the main range, corresponding. This ridge, in its Southern part, consists chiefly of a very porous amygdaloid, in which, at its South point, is an old excavation for copper. In its Northern part, it is partly composed of a peculiar Trap conglomerate, or rather brecciated amygdaloid, distinctly parallel or stratified in its arrangement.

indurated bitumen (considered as coal) was found on the back of the amygdaloid, the pores of which, in the vicinity, are occupied partly by a similar bitumen, and partly by a dark green chlorite. Copper has been found in veins in the anterior amygdaloidal range, West of the Hanging Hills, and of the range of High Rock. A similar bitumen is found in the matrix of the veins, which consists of quartz, calcareous spar and sulphate of barytes.

This anterior range presents a series of ridges or curves, corresponding to those of the main range, and like the latter, is divided into three sections, by cross valleys opposite the passes at Barnes' and Cook's Gap. The Southern of these sections commences in a short ridge, fronting the South point of the Western line of the range (1,) East of Cat-Hole. The Anterior range is perhaps continued in the amygdaloidal hummocks at the South point of the Eastern line of the same range, which extend some distance North, along the East side of the same line, still farther indicating the termination of the Fourth System at that point. The two Southern sections, as will be seen by reference to the map, form slightly interrupted ranges, very nearly parallel to the main range. A singular curve occurs at the South point of the Northern of these two sections, more advanced than the range on either side of it, and apparently forming a connecting link in front of the pass at Barnes' Gap. This more projecting curve is opposite the smallest elevation in the main range, (that of Short Mountain.) The section of the anterior range, North of Cook's Gap, is less continuous than those farther South, presenting in its middle part, a more extensive and strongly curved range, fronting Farmington Mountain, and the South part of the ridge, North of it, and two detached shorter ridges, at its two extremities. The Northern of these is more elevated than the North point of the main range behind it, and may be considered as a link, connecting the latter with the range of Talcott Mountain.

The Posterior lateral ranges of the Southern section of the present system may be next considered. These form a sys-

tem, conformable to the main range of the same section, and with a single exception, have no connexion with the posterior range, attached to the Northern section of the main range. They all apparently terminate at a point not farther North than the South point of Talcott Mountain, and of course are coextensive with the main range of the present section. They exhibit only a slight curvature at their Northern extremity, as they terminate quite too far South, to be at all influenced by the curve at the Northern termination of the present system. These posterior ranges may be arranged under two sections, a Western and an Eastern. The former of these is based on the curve, at the Southern extremity of the present main range, with one exception, apparently based on the range anterior to Lamentation Mountain. The latter section includes two ranges, based on the North limb of the third main curve. These two sections are separated towards the South, by an extensive basin (that of the Mattabesick,) in the centre of Berlin; bordered by the Western section of the posterior ranges of the present system, on the West; by the Eastern section of the same, on the N. E.; and by the N. W. point of the third main curve, on the S. E. This communicates on the South, with the basin of Beaver Pond, already noticed, and on the North, by a long narrow valley (that of Green Swamp,) between the two sections of the posterior ranges, with a similar basin (that of Little river,) West of Hartford. The route of the Hartford and New Haven Rail Road is continued along the line of depression, here indicated.

Commencing with the Western Section (P. W.,) we may first notice the most Eastern range (α_1,) namely, that based on the anterior range of Lamentation Mountain. This commences at a point N. W. from the North point of the latter, and S. E. from the North point of the range (1_1,) East of Cat-Hole, already described in connexion with the main range of the present system, and is thus, in a manner, intermediate between the Third and Fourth Systems. It extends first nearly N., to a point E. N. E. from the N. point of the range (1_1,) where it ad-

vances abruptly W., in a strongly marked curve, and bearing again N. N. E., runs out in a low point in the S. W. part of the basin of the Mattabesick, at a point about W. of Worthington meeting-house. This range might be regarded as a continuation of the anterior range of the Third System, advancing to a position more conformable to the range of the Fourth System, or as succeeding the range (^{1},) in strong receding order. It consists chiefly of a porous or fragmentary amygdaloid, often cleaving concentrically. It is fronted towards the West, at its curve Westward, and for some distance South, by an anterior range of shale, very exactly conforming in its course, to that of the range it accompanies, its strata dipping towards the front of the latter. On the back of the ridge, North of its curve Westward, it is bordered laterally, in the manner of a dike, by a mass of indurated shale.

Crossing the range (^{1}) to the West, we may now trace the Posterior ranges, based on the curve at the Southern termination of the present main range. The most Eastern of these (β) commences at a point about West of the North point of the Western line of the range (^{1},) and nearly in the line of direction (N. N. E.) of the North point of the Eastern spur of South Mountain. It may be considered as based on the N. W. point of the Western line of (^{1},) in advancing order; a long mural front to that ridge, terminating S. E. of the commencement of the present range. This range forms a long series of low narrow ridges, arranged in the usual manner, in their order of succession; through the greater part of its extent, continued nearly in a direct line N. N. E., and terminating at a point E. by S. of Cook's Gap. At a point (*) W. N. W. of the curve West, in the preceding range, it recedes abruptly East; the two ranges thus approaching each other, beyond the North point of the range (^{1}.) Farther North, at the passage of the South branch of the Mattabesick, it advances abruptly West, as if resuming its former course. In a direction S. S. W. from the S. point of this advanced ridge, one of the dikes of indurated clay, already referred to, crosses the bed of the stream, last noticed, changing

the dip of the shale, West of it, from E. to W. North of the N. branch of the Mattabesick, and consequently of the depression continued E. S. E. from Cook's Gap, it again advances West, after a considerable interruption, forming a distinct ridge, extending to its Northern termination. This range usually consists of the common crystalline Trap in front, overlaid, on its Eastern declivity, by porous amygdaloid, in some instances, with its cavities occupied by datholite. In the ridge, immediately S. of the Mattabesick (S. branch,) the Trap is underlaid, nearly to the top of the ridge, by shale; the latter presenting, at its junction with the Trap, the usual phenomena of induration; a thin band of porous amygdaloid being also interposed between them. The Trap, in this last mentioned ridge, is most elevated towards the South; the line of junction with the shale descending Northward, till it falls below the bed of the stream, at the passage of the latter. This arrangement is not unfrequent in other Trap ridges, but rarely so strongly marked as in the present instance. North of its recession (*,) the present range extends, nearly to its Northern extremity, along the Western border of the basin of the Mattabesick.

West of the South part of the range (β,) there is only one Posterior range (γ,) based on the main range of South Mountain. This commences at a point nearly equi-distant between the North points of the two spurs of the latter range, from which it is separated by a small plain. It is thus in advancing order to the Eastern spur, and in receding order to the Western, with which last it is apparently in more immediate connexion. From this point, it is continued N. N. E., in a long low ridge, nearly parallel to the Western ridge of the Hanging Hills, and running out in a low point, nearly E. of the N. point of the higher portion of the latter. This ridge, opposite its middle portion, is fronted on the West by several lower parallel ridges, nearly in the line (N. N. E.) of the N. point of the Western spur of South Mountain; one of the most Western of these appearing distinctly on its West side as a dike, bordered laterally by shale. This range, thus far, is chiefly composed of

porous amygdaloid, with a short range of crystalline Trap in the most Western of its front ridges. Opposite the North point of its longer Eastern ridge, a distinct ridge rises in advancing order, nearly opposite the S. point of a lower ridge, terminating the main range of the Hanging Hills on the North.* This advanced ridge extends, in a more irregular course, N. N. E., nearly parallel to the latter ridge in the main range, and terminates in low dike-like points, nearly E. of the N. point of the same. It consists usually of a small fragmentary, fine-grained Trap in front, overlaid East, particularly towards the North, by a porous amygdaloid, and this by a green amygdaloidal breccia, similar to that near the N. point of the anterior range of Lamentation Mountain. It terminates, towards the N. E., by a distinct recession, or curve, Eastward, in several low hummocks, chiefly composed of a light brown indurated shale, with small dikes of a fine-grained blue compact Trap, and of porous amygdaloid, along their Western fronts. The range, thus described, though based on the main range of South Mountain (^{2},) is posterior and conformable to the Western ridge of the Hanging Hills (^{3}.)

N. W. of the N. point of the range, last described, and in advancing order, another Posterior range (δ) commences, nearly in the line (N. N. E.) of the Western ridge of the Hanging Hills, and at a point about East of the N. point of Short Mt. This range extends N. N. E., nearly parallel to the main range of High Rock, and terminates towards the North, at a point about East of the N. point of the mural front along the East side of the latter range towards the South, and nearly in the same direction from the S. point of the appended Western portion of the same main range. The posterior range in question

* S. W. of the S. point of this advanced ridge, a number of low hummocks rise at the Eastern base of the main range, nearly opposite the N. point of the higher part of the latter, marking a slight flexure Eastward of the main range, at that point. The most anterior ridge of the more Southern part of the present range (γ) terminates S. of these hummocks, which thus front the recess in the present range between the front ridge, last noticed, and the S. point of the advanced ridge in question.

is of little elevation, but higher towards the South, where it is also of great width, presenting, on the West, a line of ledges of a rather small fragmentary Trap, bordered East by rounded swells of porous amygdaloid. It terminates on the N. in a narrow receding line of short detached ridges, similar in character to the front line of ledges, farther South. At its Southern termination, it is separated by a continuous valley, from the three ridges approaching it in that direction, namely, the posterior range (γ,) and the N. point of the Hanging Hills (^{3},) and Short Mountain (^{4},) in the main range, and has distinctly the appearance of an independent ridge, marked by the usual indications of a stronger elevating force at that point. Continuing farther North, from the N. point of the range, just described, across a diluvial plain, more elevated than the latter, we meet a still lower, broad flat ridge, of the same character with the latter range, and in nearly the same direction, but in receding order. Farther North, the range rises in higher ledges on the West side of a high rounded diluvial covered hill (Pine Tree Hill,) and then advances abruptly West, in a series of low parallel ridges, forming a broad tabular swell, nearly to the East side of the range of High Rock, being there separated from it only by a narrow valley. This advanced point of the present posterior range is about E. S. E. from the South point of the short ridge (^{6},) in the main range, South of Cook's Gap. It soon terminates North, at a low elevation, fronting a plain extending along the East side of the North point of the High Rock range, to the North branch of the Mattabesick. The present range (δ) properly corresponds immediately to the Eastern line of the main range of High Rock, (^{5},) commencing opposite the S. point of the latter, in a direction E. S. E., but terminating sooner towards the North.

From the preceding statement, the series of posterior ranges (γ—δ,) immediately parallel to the main range on the East, obviously corresponds to the latter, in its elevations and order of succession. We now come to a very extensive Posterior range (ε,) apparently intermediate between the posterior range

last described, and the more Eastern range (β) based on the Southern curve of the present main range. This range commences in low points, sinking beneath a group of diluvial hillocks, on the South, about E. S. E. from the North point of the Southern section of the range (δ) posterior to High Rock, and in the same direction from the North point of the mural front on the East side of that range, and from the South point of the Western appended portion of the same range. This correspondence in arrangement may be extended much farther; a remarkable advance occurring in the anterior amygdaloidal range, W. N. W. of the point last noticed, while a line continued E. S. E. would cross, nearly, the recession (*) in the next Eastern posterior range (β,) the corresponding advance in the most Eastern posterior range (α,) and also the South point of the lower Northern portion of the third main curve, and the North point of Lamentation Mountain, in the more elevated portion of the same main curve. This is only one of the many equally striking instances of conformity of arrangement, which might be detailed, if the limits of this report permitted. The present range, in its most Southern part, is of great width, with a line of high ledges of crystalline Trap along its West front, and a long gradual declivity to the East, along which extend distinct ridges of a sub-amygdaloidal (geodic) Trap, including in its cavities crystalline quartz and agates. This part of the range, in its middle portion, is bordered, both West and East, by low detached ridges of amygdaloid, in the Eastern of which that rock occasionally appears only in small dikes or veins, in a brown indurated shale. The present range is crossed, at its South point, by the South branch of the Mattabesick, at Moore's Mills, where it exhibits several interesting phenomena. In the ravine, crossing the middle ridge, is a large vein of sulphate of barytes, bordered by thin bands of calcareous spar, bearing N. N. E. in the direction of the Trap range. A little farther N. W., in the same ridge, is an apparent dike of brown indurated shale, crossing the range more obliquely (N. E.) Where the stream crosses the third (Eastern) ridge, considera-

ble quantities of indurated bitumen, considered as coal, have been found in the Trap, occupying veins, and the cavities of large quartz geodes. Different attempts have been there made in search of coal. Farther North, on the East side of the same ridge, where the Trap appears as a dike, bordered laterally by a brown indurated shale, small veins have been found, both in the Trap and the adjoining indurated shale, containing the sulphurets of lead, zinc and iron, in a matrix of quartz, sulphate of barytes and calcareous spar, also including seams of indurated bitumen. These veins have been worked to some extent as a Lead Mine. In this Southern portion of the present range, the Trap sinks on the West below the level of its base, while on the East it either dips under a parallel ridge of shale, or terminates in that direction as a dike, in the manner noticed at the Lead Mine. After a course of more than half a mile North-Easterly, this range recedes twice abruptly Eastward, and is then continued N. N. E. in a long, straight, comparatively narrow ridge, largely interrupted near its middle point, to the N. branch of the Mattabesick.

North of that stream, and consequently of the depression continued East from Cook's Gap, the present range apparently forms a strongly marked curve, advancing N. W. to the S. E. part of New Britain village. The range, for some distance N. of the stream, is partly concealed by an accumulation of diluvial sand and gravel. After resuming its N. N. E. course, it is continued, through the East part of the village, to the S. branch of Little river, across which it advances abruptly West. The ridge, East of the brook, is underlaid by shale, while that West, is overlaid by the same. The shale, in both instances, is indurated at its junction with the Trap; that on the back of the Western ridge (*,) there occupied by a porous amygdaloid, is partly converted into a dark red jasper, closely cemented to the amygdaloid. The range is then continued more N. Easterly, till it meets the West side of the valley of Green Swamp, continued Northward in that of Little river, when it abruptly recedes, and is then continued more Norther-

ly, in a high broad ridge, terminating in a low point, about half a mile South of West Hartford meeting-house. This last ridge usually presents in front a line of crystalline Trap ledges, with porous amygdaloid on its Eastern declivity. Near its S. point, at its E. base, is a singular detached hummock, presenting a short dike-like range of a fine-grained Trap, filled with veins or seams of a fine red jasper, and overlaid or bordered by a brown indurated coarse micaceous shale. The ridge at its Northern extremity, is overlaid by a similar micaceous shale. This variety of shale I have found only on the back of Trap ridges, in immediate contact with them. In the line of that part of the present range, passing through New Britain village, continued S. Westerly, in the bed of the North branch of the Mattabesick, at Hart's Mills, is a wide bed of bituminous shale, with interposed bands of a bluish compact sub-bituminous limestone, and with a dike of indurated clay, with disseminated bitumen, adjoining which the shale abounds in cross seams of brown spar, with bitumen and fluor. In a ridge of shale, parallel to that part of the range N. of the passage of Little river (*,) a similar dike of a light brown indurated shale occurs, divided into small prismatic fragments, closely cemented by seams of crystalline quartz and sulphate of barytes.

East of the South part of that portion of the present range, N. of the N. branch of the Mattabesick, a short parallel range (†) commences, E. of New Britain village, and extends N. N. E. along the summit of the high ridge, West of Green Swamp valley, running out in a low dike-like point, on the South side of Little river, as it enters that valley. This range is in the line of the preceding range S. of the N. branch of the Mattabesick, and of the most Eastern ridge of the curve, N. of that stream. A similar short range (‡) rises in strong receding order, behind the N. part of the one last described, on the E. side of Green Swamp valley, and crossing a long ridge of shale obliquely N. E., terminates in a low detached ridge of amygdaloid, in the valley next East, a short distance W. of Newington meeting-house. This range is apparently in the

line of direction of the Eastern posterior range (β,) and might be regarded as its continuation, receding strongly towards the West front of the Eastern section of the posterior ranges of the present system.

One other posterior range (ζ) remains to be noticed in the Western section. This commences N. of New Britain village, in an intermediate position between the low ridge, continued in the line of the High Rock range, and the ridge (*,) in the range (ϵ) passing through that village. It appears at first in a short even ridge, very little elevated, but farther N. is for some distance apparently concealed by diluvium, till it rises, at a point E. S. E. of Farmington Mountain in the main range, in a series of more continuous ridges, presenting, in its Southern half, three parallel subordinate ranges, a central one of compact Trap, and two lateral ranges of amygdaloid. The Western amygdaloidal range is the most elevated of the three ranges. Near its N. point, the amygdaloid, of which it is composed, abounds in agates, and has its pores partly occupied by indurated bitumen. The Eastern amygdaloidal ridge is alone continued to the N. point of the present range (on the S. side of the branch of Little river, passing by West Hartford meeting-house, and at a point about East of the S. point of Talcott Mountain.) The Trap of this Eastern ridge, near its N. point, contains seams of native copper. The middle ridge of compact Trap is continued less far N. than the anterior amygdaloidal ridge, while the Eastern amygdaloidal ridge advances into its line farther N., approaching the N. point of the anterior ridge. This last posterior range might be regarded as a continuation of the main range of High Rock, succeeding it in receding order, or more properly as a posterior range, corresponding to the third division of the Southern section of the main range (viz. that from Cook's Gap to the S. point of Talcott Mountain,) with which it is nearly coextensive, and to which it is also parallel. This range extends farther North, than any other posterior range of the Southern section of the main range.

The Posterior ranges, thus described, may be regarded as forming, with the main and anterior range, one great range, characterized by parallel ridges of Trap, with interposed bands of shale, rising in one general line of elevation. This line abruptly on the West, to the summit of the main range, and then ascends very gradually East to the depression, formed by the line of basins and valleys, already referred to, along which the route of the Hartford and New Haven Rail Road is constructed. Only two of the posterior ranges, above described, (3—4) are situated E. of the route of that road, and these may be considered as lines connecting the line of elevation in question, the former with the third system, and the latter with the Eastern section of the posterior ranges of the present system. In crossing the line of elevation, above mentioned, by a section across the High Rock range, we meet five different ranges of Trap, between the East Plain, in Southington, and the central basin, in Berlin. Sandstone underlies the Western of these ranges; the others are separated by bands of shale. The shale appears both underlying and overlying, at different points of these ranges; but in other places, these ranges appear obviously as dikes, rather than as intercluded masses. These posterior ranges might be considered as forming three leading ranges; an Eastern, formed by (3—†—‡) and more immediately connected with (2) appended to the main range; a middle, formed by (*—5—6) and connected, in like manner, with the main range of the Hanging Hills; and a Western, formed by (1) connected in the line of the main range of High Rock. These posterior ranges present numerous conformities, in elevation and arrangement, both with each other, and with the main and anterior ranges. These are represented, in the map accompanying this report, by dotted lines crossing them transversely.

(P. R.) The Eastern Section of the posterior ranges, corresponding to the Southern section of the present main range, presents two distinct ranges, based, as has already been observed, on the Northern limb of the third main curve. The Western

range (1) commences, on the South, in a low point, nearly North of the point where the Mattabesick crosses the third main curve, and soon forms a high broad ridge, exhibiting several parallel lines of elevations, and presenting a distinct curve, nearly parallel to the first curve in the third main range, East of the Mattabesick, but in a direction more N. Easterly. This is succeeded by a series of similar but lower ridges, bearing successively more to the North, until at the passage of the Middle Hartford Turnpike, the range assumes a N. N. E. direction, nearly parallel to the corresponding part of the fourth main range. This range thus apparently, at its commencement, conforms nearly in its direction to the third main range, (resembling, in this respect, the commencement of the latter range, in Paug Mountain,) and gradually, as it proceeds Northward, wheels into a position, conformable to the fourth main range. After passing the Middle Turnpike, it extends N. N. E. in a long, nearly uniform ridge, that of Newington Mountain, about equal in elevation to that at the Southern termination of the range; interrupted only by one valley, crossing it N. N. W., at an abrupt recession East, and at last terminating in a low point, also with a slight recession East, just N. of the S. road from Farmington to Hartford. At a point N. E. from this termination, a dike of indurated clay crosses the bed of a small stream, flowing N. to Little river, accompanied with the same disturbance in the strata, already noticed, and apparently indicating a recession in the Trap range to that point, and thus marking a distinct curvature at its Northern extremity.

The Eastern range (2) commences, towards the South, on the West bank of the Connecticut, at Rocky Hill landing, more than a mile N. of the E. point of the third main curve. It forms, at first, a long ridge bearing N. N. W., with a line of ledges of fragmentary Trap, along its West front, and a steep declivity of amygdaloid, on the East, extending to the meadows of the Connecticut. This ridge, known as Rocky Hill, forms a distinct curve, particularly towards the South, and ter-

minates, towards the North, on the S. bank of Piper's brook, adjoining the Middletown Turnpike. The range then advances W., across a wide valley, in which is a large bed of bituminous shale, containing fish impressions, and recently excavated for coal. It is then continued N. Westerly, in a lower, more amygdaloidal ridge, apparently overlaid, on the N. East, by a similar bituminous shale. At a point about East of the passage of the Middle Turnpike across the preceding range, the present range becomes more elevated, and turns Northerly, in a direction nearly parallel to the preceding, but in slightly advancing order, assuming a N. N. E. direction, parallel to the fourth main range, opposite, only at a point about East of the N. point of the preceding range. It there forms a long uniform ridge, called Rocky Hill, with a line of abrupt ledges of compact Trap, along its West front, and a very gradual slope of amygdaloid towards the East. This ridge terminates, towards the North, in low swells of amygdaloid, at some distance S. of Little river; but at a point farther N. East, at the excavation of the Rail Road, just West of its depot, is a mass of dark greenish indurated shale, highly contorted, and disturbed in its dip, with seams of bitumen and calcareous spar, and with traces of copper (also occurring in the Trap of Rocky Hill,) apparently indicating the continuation of the Trap in that direction, and thus increasing the curvature of the range towards the North. The present range forms a very distinct and regular curve, and may be viewed throughout its whole extent from both its extremities. Like the posterior curve (P. 2 S.) of the third system, it is the only range which presents distinctly the proper curvature of the fourth system; the main range, and the more Western posterior ranges, being all disturbed, at their Southern termination, by the N. part of the third system. This range is overlaid, at the passage of the Middle Turnpike, by the dark brown indurated micaceous shale, already noticed.

The Northern Section (2) of the present main range, including all that part of it extending from the South point of Tal-

cott Mountain to its N. E. extremity, is as remarkable for the simplicity of its arrangement, as the Southern section for its complexity. While that exhibits a distinct anterior range, throughout its whole extent, and two subordinate systems of posterior ranges, including at least five distinct ranges, this presents only a single posterior range, and an anterior range, only for a short distance. While that, too, exhibits a broken range of detached elevations, separated by deep cross valleys, particularly in its two Southern subordinate sections, and forming, in the whole, a strongly marked curve, the present section presents a comparatively unbroken and continuous range, with very slight curvature, except at its Northern extremity. This section may be divided into three subordinate sections, each of which commences, on the South, with a remarkable elevation, running out, in a comparatively low point, at the opposite extremity. These sections commence, respectively, at the South point of Talcott Mountain, at that of Newgate Mountain (Granby,) and at that of Mt. Tom. Viewed in relation to the arrangement of its parts, the present section might be divided into two sub-sections, in the same manner as the Southern, by the pass at Cook's Gap. This division occurs at the passage of Westfield river, where the range is crossed by a nearly directly transverse valley, receding towards it from the South, and advancing rather abruptly from it, towards the North. The range, however, is of comparatively little elevation, in both directions from this point of intersection. That part of the range, towards the North, presents a strongly marked curvature, while that towards the South, deviates but little from a direct line.

(1.) The most Southern of the subordinate sections, first indicated, includes that part of the main range, extending from the South point of Talcott Mountain, to the South point of Newgate Mountain. This forms a long nearly straight range; deeply intersected only by the narrow ravine, at the passage of Farmington river; of nearly uniform height, in its Southern half, but gradually diminishing in elevation, towards

the North. It presents a series of ridges, separated by elevated passes or depressions, and succeeding each other mostly in receding order. Of these, the Southern is the longest and most elevated, occupying nearly one third of the whole section, and is marked by a very uniform outline. It commences, on the South, in a bold point, somewhat in advance of the North point of the Southern section of the main range, and terminates in an equally bold point, on the North. The summit of this ridge usually presents two distinct terraces; a lower, composed of a greenish sub-amygdaloidal Trap, containing traces of copper, in several different localities, and in its Southern part, prehnite, in seams or plates; and a higher, composed of a dark compact crystalline Trap. A ridge, in the latter terrace, South of the pond, at Montevideo, is underlaid by a friable red shale, interposed at a large angle, between it and the lower sub-amygdaloidal terrace. The latter, from this circumstance, as well as from the character of the rock, and its accompanying minerals, here apparently represents the anterior range, fronting the Southern section. The main range is bordered on the East, throughout the whole extent of this ridge, by a distinct, but closely parallel ridge, continued nearly in the line of the North point of the Southern section of the main range. This commences, on the South, in a bold point farther North than the South point of the present section of the main range, and forms a comparatively high ridge, South of the Albany Turnpike, but is only slightly elevated farther North. It is separated from the main range, by a long narrow valley, in which I have observed no appearance of shale, in place. At its North point it is continuous with the main range, farther North, which last succeeds it in slightly receding order. The second ridge, in the present section of the main range, is separated from the North point of Talcott Mountain, by a depression at the Weatogue pass, opening North from the valley last noticed. It succeeds the latter ridge, in strong receding order, as already indicated, and after a comparatively short course, terminates at another depression (that of Adams' Gap,) crossing

the range obliquely S. E. The next ridge, of about equal length, commences in slightly receding order, and is continued to the passage of Farmington river, beyond which extends a series of short and low elevations, receding for the greater part of the distance, but slightly advancing towards the Northern extremity of the present section. At the passage of Farmington river, there is a slight recession in the range, which has probably caused the passage of the river at that point, rather than a rupture by violence.

(2.) The second subordinate section, as first indicated, extends from the S. point of Newgate Mountain, to the S. point of Mt. Tom. This presents, in its Southern part, two more elevated ridges, separated by a pass, about East of the North point of Manituck Mountain, in the Western line of elevation. The Southern of these (Newgate Mountain,) rises S. E. of Newgate Mine, along the East side of which it extends, with a mural front West. A remarkable anterior range (A) may here be noticed, commencing opposite the point, in the preceding section, where the latter begins to advance, as above indicated, and terminating at the Newgate Mine, opposite the West front of Newgate Mountain. In its South part, this anterior range is chiefly composed of a brecciated amygdaloid, already noticed, and in its North part, of a light blue ferruginous felspathic amygdaloid. The S. copper mine (Granby,) is contained in the brecciated amygdaloid, on the East side of the range, near its Southern extremity, and the Newgate Mine, in the partially indurated sandstone, underlying the range, at its Northern extremity. The copper of the South mine is chiefly contained in the seams of indurated clay traversing the amygdaloid; that of the Newgate Mine in interstratified masses, in the sandstone. This anterior range is separated from the main range by a band of friable red shale, in the same manner as the anterior ranges fronting the main range, S. of the present leading section. The second ridge, above noticed, in the present sub-section, terminates near the North line of the State, beyond which the range is continued in a series of lower, slightly rece-

ding elevations, to Westfield river. Here it advances rather abruptly, in a series of similar elevations, forming, however, a well marked curve, terminating at a depression, at the West road from Springfield to Northampton. A quarry of limestone occurs in this vicinity, employed in the manufacture of cement; but not having visited it, I am unable to point out its precise relations to the Trap range. North of this depression, the range advances slightly to the Northern termination of the present sub-section, in the same manner as already noticed at the Northern termination of the preceding.

(3.) The Northern subordinate section commences at the South point of Mt. Tom, where the range rises abruptly to the most elevated summit, in the entire Trap system of the present Secondary formation. This extends N. N. E., in a long nearly uniform ridge, with a mural front to the West, on a very elevated base, and receding somewhat, sinks rapidly to the Connecticut below Northampton. East of the river, the range bends abruptly East, in receding order, and is continued, in that direction, in a line of high detached elevations, separated by transverse depressions, on the general summit of the range, to the road from Amherst to Granby. The most Western of these elevations (Mt. Holyoke) is celebrated for the fine view it commands from its summit. East of the road above noticed, the range is continued in a series of low, usually dike-like elevations of Trap, apparently extending across the North points of a group of sandstone ridges, ranging N. Easterly across the line of the Trap range, farther West. This group of sandstone ridges, with its accompanying Trap, terminates on the West side of a narrow plain, separating it from the Eastern Primary. The Trap, at the N. Eastern termination of the present section, apparently presents little or no curvature to the South, but the sandstone ridges, just noticed, project a considerable distance in that direction, and are obviously connected, in elevation, with the Trap range, whose curvature they in some measure serve to complete.

The only distinct Anterior range, fronting the Northern sec-

tion of the present main range, so far as I have observed, is that already noticed, connected with the copper mines in Granby. The remarkable band of shale, interposed between the highest terrace of compact Trap, and the lower front terrace of sub-amygdaloidal Trap, on the summit of the main range, at Montevideo, as well as the more general occurrence of a similar lower terrace along the West front of the main range, apparently indicate that the Anterior range, which is distinctly separated in the third main curve, and in the Southern section of the present (fourth) main curve, although there a part of the same general elevation, is, in the present section, combined in the same mass with the main range. In the first and second main curves, and in the Southern part of the third, the anterior ranges are generally more remote, and form lines of elevation entirely distinct from the main range.

Only one distinct Posterior range has been observed by me, connected with the present section. This forms a long, low, nearly straight ridge, or series of ridges (P,) closely parallel and conformable to the main range it accompanies, and usually at a distance behind it, of less than half a mile. It first commences distinctly, at a point behind the Southern extremity of the main ridge, North of the Weatogue pass. Farther South, it may be occasionally traced in low dike-like points, to a short distance S. of the Albany Turnpike, in a direction leading towards the N. point of the posterior range (ζ W.) of the Southern section of the present main range, with which it is perhaps continuous, its most Southern part being less developed, or concealed by diluvium. N. of the point behind the Weatogue pass, it is continued in a slightly interrupted ridge, usually of little elevation, at least to a point W. of West Suffield meeting-house. Its precise termination, towards the North, I have not ascertained. It is separated throughout, from the main range, by an interval, occupied by shale. It conforms in its arrangement generally to the main range, presenting a series of similar elevations

and depressions, but less distinctly marked. Thus at the passage of Farmington river, it terminates in a low point, on the South, and soon rises abruptly to a greater elevation, on the North. In all the rest of the extensive tract of the Secondary, East of the present section, including the whole of the Secondary, East of the Connecticut, I have observed no indications of Trap in place.

W. *The Western Line of Elevation.*

The Western line of elevation, as has already been stated, includes two subordinate lines of elevation (sections,) separated by a wide interval of sandstone, in each of which are two main curves. These subordinate lines of elevation, as well as their main curves, are in a relation to each other, the reverse of that which prevails in the Eastern line of elevation; the Southern being more extensive than the Northern, and the Southern curve in each, in like manner, exceeding the Northern. The Western line of elevation may be considered the complement of the Eastern, being most largely developed, where the latter is least so, and apparently quite suppressed, opposite those points of the latter of greatest extent and magnitude. Thus the smaller Northern line of elevation fronts the larger Northern curve in the Eastern line, and also one of the least elevated portions of the latter, namely, the Northern part of the section commencing with Talcott Mountain. The larger Southern line of elevation, on the contrary, fronts the three smaller Southern curves of the Eastern line, and the larger Southern curve, in the same Western line, is opposite the two smallest of those curves in the Eastern line, while the smaller Northern curve is opposite the largest of those curves, namely, the third. The Western main curves, at the same time, do not correspond with the Eastern, but rather form links connecting two of the latter, like the exterior anterior range of the second Eastern system. Thus the most Southern Western curve extends from a point opposite the West front of the first Eastern system, to a point opposite that of the third, entirely including the second. The Northern curve in the

Southern section of the W. line, in like manner, extends from a point opposite the Southern part of the third Eastern system, to a point nearly opposite the S. W. termination of the fourth Eastern system, at the Hanging Hills. The Northern section of the Western line connects, in a similar manner, the West front of the Southern division of the Northern section of the fourth Eastern system, with the West front of the second division of the same section. These details will serve to indicate a degree of systematic arrangement in the distribution of the Trap ridges of the present Secondary formation, such as could only have arisen from the operation of a general law. The Western line of elevation is apparently suppressed opposite the Southern most developed section of the fourth Eastern system, and also opposite the remarkable elevation of Mt. Tom, in the same Eastern system, or is represented, at those points, only by conformable ridges of sandstone. The near approach of the Primary, at least partly separating the Northern and Southern basins of the present Secondary formation, has apparently prevented any anterior range of Trap, fronting the Northern limb of the fourth Eastern main curve.

(W. S. I.) The Southern Main Curve, in the Southern Section of the present line of elevation, includes the remarkable elevations of East Rock, West Rock, and Mt. Carmel. The former of these, with its appendages, forms a distinct subordinate curve, connected by the intervening ridges of Mill Rock and Pine Rock, with the main body of the present curve at West Rock.

The range of East Rock (1) commences in a lower appended ridge, on the S. East, chiefly occupied by sandstone, with a line of dike-like elevations of Trap, along its Eastern side, forming a short well-marked curve, bordered on the West by a higher front of sandstone, which, towards the Trap, is remarkably indurated, to an unusual width, and like the Trap, breaks more or less freely in jointed fragments. The Trap is also bordered on the East, by a range of less indurated sand-

stone, which towards its N. point contains small dikes of Trap, the range of the latter receding into that position. This curve is succeeded, nearly in continued order, by the main curve of East Rock, including the principal summit, and a detached elevation to the S. E. The latter curve is directed more to the West, than the preceding; its chord extending about N. W., and that of the preceding, hardly N. N. W. The detached elevation is fronted on the S., in the manner of a dike, by indurated sandstone, in the same ridge as that fronting the preceding curve. The main summit of East Rock also appears as a dike, in front, at its S. E. point, while at its middle point, it apparently is underlaid by sandstone. In two points, on the back of the ridge, the Trap is bordered by masses of highly indurated sandstone; one, near its S. E. point, appearing as the wall of a dike, and another in the middle of its curve, more as an overlying mass, but highly inclined. At its N. W. point, the Trap runs out between two lateral swells of indurated sandstone.

The range of Mill Rock (2) commences in a high pointed summit, N. of the N. W. point of East Rock, from which it is separated by interposed sandstone.* From this point it extends W. N. W., crossing Neck river, at Whitneyville, and thence is continued to a point nearly one third the distance to West Rock. Throughout this whole extent, it has the obvious character of a dike, usually of very considerable width, but composed of a series of elevations, succeeding each other in the usual manner of Trap elevations, but nearly in continued order. The sandstone adjoining the dike is less indurated towards the East, than towards the West, where the latter is bordered in front by a range of light grey very indurated coarse sandstone, rather more elevated than the Trap. Not far West of the point where it crosses Neck river, the range of Trap is interrupted in front, for a short distance,

* A short series of low dike-like elevations of Trap rises S. S. E. of this elevation, nearly in the line of the N. W. point of East Rock, but slightly receding, and is continued North nearly to the S. E. point of the same elevation.

leaving a recess in the ridge, behind which rises a ridge of sandstone, in the line of the sandstone, bordering the dike on the North. The sandstone in the S. front of this ridge is much indurated, and traversed by small veins of Trap, in the direction of the dike, and by seams of dark green chlorite. In the plain, North of the ridge, at this point, rises a low parallel ridge of Trap, apparently replacing the defect in the line of the dike in front. The range in question presents a singular arrangement, in its relation to the adjoining sandstone; that part of it East of Neck river, being bordered on both sides by walls of sandstone at a much lower elevation than the Trap; that part from Neck river to the recess, above referred to, being bordered by sandstone only on the North, the Trap sinking below the base of the ridge on the South; while that part West of the recess, is bordered on the summit of the ridge, only on one side, however, by a line of elevations of sandstone of nearly equal height, in its Eastern half, on the North, and in its Western half on the South, as already noticed.

The entire range, thus far described, commences on the S. E., opposite the dikes in advance of the Western anterior range of the first Eastern system, at the Middletown Turnpike. It might be considered as a continuation of the same elevating force, successively deviating more and more from the direction of that system, towards the South point of the main range of the Western curve, now in question; the three subordinate ranges composing it, varying in direction from N. N. W. to W. N. W.

Crossing an isthmus of the New Haven and Hamden plain, at the passage of the Farmington Canal, we meet a similar dike-like range, that of Pine Rock (3,) directed W. S. W. towards the S. E. point of West Rock. This forms a nearly straight ridge, occupied in its Eastern part, by a higher more uniform line of Trap, abrupt to the South, where it apparently sinks below the level of the adjoining plain, and bordered on the North, by a highly inclined mass of indurated (porphyroid) sandstone. This, however, is exposed only towards the

West; the ridge being covered, towards the East, in that direction, by accumulated diluvium. The Western termination of this range, is occupied by a more strongly curved series of shorter elevations of Trap, bordered by sandstone, either vertically or inclined. On the back of one of these ridges, nodules of extremely indurated sandstone are found firmly imbedded in the Trap. Such appearances also occur in other instances, particularly on the back of the West Rock range. The present range commences towards the East, in a low short hummock of Trap, rising out of the sandy plain, adjoining the range on the South and East, behind which the main ridge, above described, rises in receding order. The Western part of the range also succeeds the Eastern part in similar receding order, being separated from the latter, by a depression crossing the ridge N. Easterly. The ridge, with nodules of imbedded sandstone, extends along the W. side of this depression, towards the North.

The series of ranges, from the S. E. point of the East Rock range, to the S. W. point of Pine Rock, presents as many points of interest, in regard to the arrangement of the Trap, and its relations to the sandstone, as occur in any part of the entire Trap system. A detailed description and explanation of these would occupy an extensive chapter. The present main curve thus, at its Southern extremity, crosses the country in a broken line, nearly from East to West, in a manner similar to the arrangement at the S. point of the fourth Eastern main curve, at the Hanging Hills; assuming its more regular curvature only at West Rock. This may perhaps be explained by the peculiar arrangement of the Eastern border of the Western Primary, S. of West Rock; the subordinate ranges of the Chloritic formation (A,) being directed N. Easterly, towards the South front of the range in question.

The present main curve rises abruptly at West Rock, presenting a bold mural front to the S. S. W., but terminates, towards the S. E., in a low appended ridge, bearing around E. N. E. towards the S. W. point of Pine Rock. The curva-

ture at the S. point of the West Rock range is very distinctly obvious on the back of the ridge, where the Trap is overlaid by a very light grey indurated sandstone, in which traces of copper may be discovered. Farther N. the Trap is occasionally overlaid on the East by indurated sandstone, or bordered by it, in the manner of a dike. Imbedded nodules of the same also occur on the back of the ridge, sometimes at a considerable elevation. The present main curve from West Rock, Northward to where it recedes East towards Mount Carmel, forms a long uniform ridge (4,) intersected only on its summit, with a mural front on the West,. towards a narrow valley, dividing it from the Western Primary (B.) On its Western side, scarcely a mile N. from West Rock, a remarkable spur, already referred to, projects from the front of the range, composed of a fine-grained very hard Trap, arranged in nearly horizontal columns, and bordered laterally, in the manner of a dike, by indurated sandstone. This spur, at the summit of the range, does not pass directly into the Trap of the latter, but is deflected Northerly for a short distance, into the line of the range, terminating in a low point, separated from the main summit by a slight depression. The Trap on the summit adjoining is very coarse-grained, and comparatively decomposable. This spur is nearly opposite the N. E. point of the S. Eastern dike, in the Western Primary, which it also resembles, in the character of its Trap; thus apparently indicating the passage of the latter into the West Rock range, connected with the Secondary. This latter range, at its Northern extremity, apparently interlocks with the Northern curve, in the present line of elevation. It terminates abruptly, in that direction, in a short ridge, bearing E. S. E., from which the latter curve extends W. N. Westerly, in a closely connected range.

In a direction, S. Easterly from the N. E. point of the West Rock range, as above described, a small dike-like range of Trap (5) commences, and extends N. Easterly along the West side of a high ridge of sandstone, intervening in the line of the present main curve, between the ranges of West Rock and

Mount Carmel. It terminates in a low point on the N. side of that ridge, near the Farmington Canal. Throughout the greater part of its course, it is distinctly a nearly vertical dike, although, along the Western side of the ridge, above noticed, it presents a low mural front to the West. East of this dike, on the summit of the ridge, is another short range of more detached elevations of Trap, which, after a short interruption, appears again, in receding order, at the East base of the ridge, and is thence continued N. Easterly, across the Canal and Neck river, at the Steps, in a line of low hummocks, to the S. W. point of Mt. Carmel (6.) In a low ridge, farther S. E., two or three small points of Trap may be noticed, forming a small parallel appended range, terminating in a low point, East of the Canal.

The range of Mount Carmel (6) forms an elevated ridge, bearing E. N. E., remarkable for its extent and peculiar arrangement; presenting a broad range of Trap, along its summit, bordered on each side, at a comparatively low elevation, by sandstone. The sandstone rises to a greater height on the North side of the range, which corresponds to the Western front of the curve farther South. This range presents, on its summit, a series of elevations, succeeding each other in receding order; the two Western forming a single line only, but those farther East arranged in two distinct lines, separated by a valley (Paine's Hole,) on the summit of the range. The ridge on the N. W. side of this valley presents a mural front towards the latter, in advance of which is an isolated column of Trap, similar to that noticed on the W. front of (2 E. III.) At the S. E. point of the entire range, is a single bold detached point, apparently indicating a curvature, at that extremity, towards the South. The most Western elevation in the range is detached from those farther East, by a singular ravine, opening N. Easterly, bordered on the West by a high mural front, remarkable for the large fallen blocks at its base. Native copper is found in seams in the Trap, near the N. E. point of the range, and a large mass of the same is said to have been for-

merly detached from the surface of the rock, on some part of its summit. The Trap of this range is generally coarse-grained, breaking in large blocks; towards the Eastern point of the mountain especially, it is very decomposable.

East from the high range of Mount Carmel, a lower range of sandstone (7) extends, in the same E. N. E. direction, to the West bank of the Quinipiack, near the line of North Haven and Wallingford. This sandstone range is accompanied by two nearly parallel dike-like ranges of Trap, apparently in continuation of the two lines of elevations on the summit of Mount Carmel. One of these extends along the North side of the sandstone range, and terminates in a dike at its base, about half a mile West of the Middle Turnpike. The other extends along the S. E. side of the range, in a series of detached dikes, in receding order, and terminates in a low broad ridge of Trap, at the N. E. point of the range, crossing the Middle Turnpike to the West bank of the Quinipiack. The sandstone adjoining the Trap of these ranges, is singularly altered and indurated, and is accompanied with a light yellow mineral (epidote,) in small geodes, and in disseminated stains and patches. This mineral occurs most remarkably, in a ledge of indurated sandstone, fronting the S. E. point of the high range of Mount Carmel, from which it is separated by a narrow valley, opening South. It is also disseminated in a light reddish felspathic sandstone, (forming irregular beds in the common red sandstone of the range,) even at points quite remote from the Trap. The N. E. point of the present Trap range (forming also the N. E. point of the present main curve,) terminates nearly opposite the S. point of the Exterior Anterior range of the Third Eastern System.

The present main curve is not accompanied by any anterior lateral range, unless the range, extending Easterly, North of Mount Carmel, be considered as anterior to the latter. This however, will be described as posterior to the Northern main curve of the present line of elevation. The only Posterior range, subordinate to the present main curve, is found in a

small dike, adjoining the Canal, just North of Judge Bassett's (Hamden.) This appears in two excavated points, apparently near the N. and S. extremities of a small well marked curve, conforming to that of the main range; the direction of the dike, at its S. extremity, being N. Westerly, and at its N. extremity, N. Easterly.

(W. S. II.) The Northern Main Curve of the present line of elevation begins in connexion with the N. point of the West Rock range, as above indicated. Its precise arrangement, at its point of connexion, I have not satisfactorily determined. A detached elevation of Trap rises N. E. of that point, apparently indicating the commencement of the Northern curve, which farther S. W. touches the convexity of the Southern curve; the two being thus arranged, in a manner similar to the two first Eastern main curves, but with a nearer approximation.* The Northern curve first advances strongly W. N. W., to the S. point of a long detached ridge, ranging nearly North, but with a wide front to the South, indicating a curvature Eastward, at that extremity. This latter ridge, at its S. W. point, extends, for some distance, along the East border of the N. E. point of the Argillitic formation (B W.,) but is separated from it, by a thin band of sandstone, indurated, and of a dark purple, adjoining the Trap. Opposite its West front, near its middle point, the range advances abruptly West, across the North point of the argillite (B,) in a series of short detached ridges of Trap, rising immediately from the argillite, and arranged in two or three parallel lines of elevation, uniting towards the N. in a longer ridge, parallel to the preceding, and extending N. into the sandstone of the Secondary. The main range then advances N. W. across a valley opening South, to the S. point of a long slightly interrupted ridge of Trap, extending Northerly, along the Western border of the Secondary, and apparently adjoining the Eastern border of the Mica Slate forma-

* The Southern curve, viewed in this relation, should be considered as terminating at the N. E. point of the West Rock range (4.)

tion (C W.,) at its N. E. termination. This ridge recedes slightly towards the North, and then advances abruptly in a high rather pointed summit (Gaylord's Mountain) (†,) at the N. W. point of which, the range is intersected by a valley opening N. E. North of this, it is continued in a similar ridge, apparently adjoining the Eastern border of the Porphyritic formation (D W.,) and crossed near its middle point by a small stream (Roaring Brook,) noted for its picturesque cascade. The range of Trap is there overlaid by sandstone, more highly inclined than usual, and indurated adjoining the Trap; a fine section of it being exhibited by the ravine, through which the brook passes. Veins of datholite occur in the Trap, in the bed of the stream, near its junction with the sandstone. Farther N. the range recedes abruptly, at a narrow pass opening N. N. W., and is then continued, in its former direction, to the Cheshire and Waterbury road, where it sinks to a low level, and is again interrupted. It then recedes N. N. Easterly from the Primary, in a long uniform ridge, terminating West of the Canal, near its culvert (S. of Southington,) and receding abruptly East, at its N. point, in low detached amygdaloidal hummocks. Farther S., on the East side of this ridge, is a very coarsely crystalline hornblendic Trap, formerly excavated as an iron ore. The range recedes still farther East, across the Canal, and is then continued N. along the West side of a sandstone ridge, to the Quinipiack, at the Farmington Turnpike, and at last terminates, about half a mile farther N. E., in a low ridge, in strong receding order, sinking at its N. point, beneath the S. escarpment of the higher Eastern plain, in Southington, at a point about W. N. W. of the S. W. point of the Fourth Eastern System. This range presents a well marked curvature, extending, in its middle part, along the Eastern border of the Western Primary, but receding from the latter, at its two extremities. Generally along its Western base, where it adjoins the Primary, diluvium is so accumulated as to conceal its point of junction, but its immediate connexion with the Argillite (B) is perfectly obvious.

The present main curve is accompanied with two Posterior lateral ranges, each of considerable extent, and presenting a peculiarity in their arrangement, to which no exact parallel is found in any other part of the Trap system. Of these, one extends Northerly, and may be regarded as corresponding directly to the present Northern main curve, to which it is nearly parallel, while the other ranges Easterly, as if conformable to the N. limb of the Southern main curve, at Mount Carmel.

(P. 1.) The first of these ranges commences at a low point, on the East side of Neck river, N. of the West point of Mount Carmel, and nearly in the direction of the long dike-like range (5,) continued. It soon rises to a considerable elevation, extending N. N. E. along the West side of a sandstone ridge, presenting a low mural front to the West, and bordered East by a nearly vertical wall of indurated sandstone, forming apparently a dike partly exposed towards the West. This resembles the arrangement already noticed in the circular range at the S. extremity of (A. 3 E. I,) and in other instances in the Eastern line of elevation. The range continues in the same direction, with slight interruptions, to Gaylord's Mine, in the S. E. part of Cheshire, where it is crossed by the East—West range. North of that point it is continued in a low narrow ridge, in a direction more nearly North, pointing towards the S. W. point of the Hanging Hills (fourth Eastern main curve,) and at last runs out in a low point, in an extensive basin (Broad Swamp,) E. of Cheshire village. This range, throughout a great part of its extent, exhibits more or less striking indications of copper, and has been excavated, in several places, for that mineral, particularly at Gaylord's Mine, just noticed, and at Talman's Mine, in the high ridge, at its Southern extremity. The copper is usually found in the indurated sandstone, immediately adjoining the Trap; less frequently in the latter. The range, in that part of it N. of Gaylord's Mine, is in part composed apparently of distinct short dikes, crossing the range obliquely North-Easterly, and separated by interpo-

sed bands of sandstone, in which copper has been also detected. These dikes may be considered as corresponding to the usual elevations of Trap, succeeding each other, in slightly advancing order, from which circumstance, the ridge probably derives its more Northern direction.

(P. 2.) The East—West range apparently commences in a short dike-like range, rising near the N. E. point of Gaylord's Mountain, and extending to the W. side of the valley of Neck river at J. Brooks', in the S. W. part of Cheshire. Less than half a mile S. E. of this point, a series of very small dikes of Trap occurs in an indurated sandstone, on the West side of the same valley, apparently forming a parallel range. In a direction E. N. E. from these ranges, on the E. side of the valley last noticed, and separated by a wide interval, in which no Trap has been observed, the range again commences, in the same dike-like form, but presenting a series of more or less detached elevations, arranged in the usual manner of Trap ridges, in nearly continued order. It extends thus Easterly to Gaylord's Mine, where it crosses the preceding range, and is continued still farther East, in a less direct course, presenting a series of subordinate curved ridges, more or less detached, until it terminates on the West side of the Quinipiack, West of Wallingford meeting-house. At its Eastern termination it bends distinctly South, towards the N. E. point of the Southern main curve, and presents a very complex arrangement of curves and dikes, for the details of which reference may be made to the map accompanying this report. Gaylord's Mine, already referred to, is situated in the indurated sandstone, on the N. side of this range, just West of its intersection with the preceding range.

One other small range (P. 3) may here be noticed, occupying a position intermediate between the Eastern and Western lines of elevation, and extending Northerly, in a direction nearly parallel to the N. part of the North—South range (P. 1.) It is first observed in a small dike of a green fragmentary wacke-like Trap, not far W. of Yalesville, in the road leading

to Cheshire. It is next exposed, in the same direction N. N. E., near the E. bank of the Quinipiack, less than half a mile West of the Hartford and New Haven Rail Road, forming first a low dike-like swell in the plain, and thence continued North about half a mile, on the East side of a sandstone ridge, strongly advancing at its N. point, where it terminates with a distinct flexure East. The Trap of this range is generally small fragmentary, and dark green chloritic, particularly at its N. point, where it is intersected by veins of calcareous spar, accompanied with seams of chlorite, and has been excavated for copper, although no traces of that mineral were observed by me in the rubbish of the excavation. This range commences nearly East of the N. point of the preceding N.—S. range (P. 1,) and might be considered as a continuation of the same, in strong receding order.

The range of Mount Carmel, and the posterior ranges North of it, front the Southern termination of the fourth Eastern main curve, and by their elevating force, may have caused the recession of the latter range to the East, similar to that of the Southern main curve of the present line of elevation, from West to East Rock. The remote position of the range of Mount Carmel, while it has disturbed the curvature of the fourth Eastern main curve, has not interrupted it. The S. point of the third main curve, on the contrary, from its near position to the N. point of Toket Mountain, is interrupted, the curvature of that system being only continued in its posterior range (P. 2 S.)

(W. N.) The Northern Section, in the Western line of elevation, commences, on the South, as already stated, nearly opposite the middle of the West front of Talcott Mountain. The long interval between it and the N. point of the Southern section, is occupied, in the direction of the present line of elevation, by a range of sandstone, usually of little elevation, presenting a series of ridges, succeeding each other much in the same manner as the different ridges or elevations in Trap ranges. Dikes of Trap occur, in the line of this range, at the

passage of Farmington river; and about a mile farther North, a short curvilinear range of Trap (†) extends along the W. side of the range of sandstone, there separated only by a narrow valley, from the Western Primary. This range of sandstone, apparently replacing the Western line of Trap, extends in front of the Southern, more largely developed section of the fourth Eastern system, and the small localities of Trap, just noticed, appear in front of the S. part of the Northern section of the same system, at Talcott Mountain. The Northern section of the present line of elevation begins in a bold point, not far N. of West Avon meeting-house, from which a slightly interrupted range extends N., in continued order, along the Western border of the Secondary, to near the N. W. corner of Simsbury, when it bends East abruptly in a similar receding range, terminating in two remarkable summits, separated by a deep valley, crossing the range nearly directly from North to South, from which circumstance they have been called the Barn Door Hills. At this point, terminates the Southern main curve of the present section, strongly marked only in its Northern limb.

This Southern Main Curve (1) may be divided into three subdivisions, separated by deep cross valleys; namely, a Southern, a Middle, and a Northern. The first of these (α) extends nearly N.—S., East of the Canton gneiss basin (G N. 1 ° W.,) presenting two more elevated points at its Northern and Southern extremities, and apparently immediately approaching the Western Primary, at the S. end of its Northern elevation, near the N. E. point of the Canton basin. On the Eastern declivity of its Northern elevation, a coarse hornblendic variety of Trap occurs, similar to that already noticed, in the same relative position, near the North point of the Northern curve of the preceding section, and like that, also taken for iron ore. The second division (β) commences, in receding order, in two low detached elevations, rising on the Western border of the plain, West of Simsbury, whence it extends N. in a high continued ridge, immediately adjoining the Western Primary, and

at its N. point sinking abruptly to the valley of a small stream, flowing East, where it is bordered East, apparently in the manner of a dike, by singular varieties of indurated sandstone. The third division (γ) includes that part of the range receding Easterly to the Barn Door Hills, and consists of a series of more detached elevations, forming a continued ridge, and arranged distinctly in receding order. Although the valley at the Barn Door Hills crosses the range nearly directly, yet a dike-like spur extends S. W. from the Eastern of those summits, crossing the S. opening of the valley, and separated on the N. W. from the N. E. point of the Western summit, by a band of indurated sandstone.

From the N. East point of the Eastern summit, the Northern Main Curve (2) of the present section, extends N. Easterly, in slightly receding order, in a series of low ridges, scarcely rising above the plain, West of the Church village in Granby, to the S. point of the range of Manituck Mountain, which, after a slight advance, terminates in a long high ridge, opposite the Northern lower part of Newgate Mountain (fourth Eastern main range,) ending abruptly at the S. W. extremity of the Southwick Ponds, and nearly W. of the N. point of Newgate Mountain. This Northern range presents less deviation from a straight line, than any other leading member of the Western line of elevation.

The ranges, now described, include all the distinct localities of Trap observed by me, in the Southern basin of the larger Secondary formation. No other range of any great extent, I am confident, can be found in this basin; but small points may be discovered, which have escaped my observation. The sandstone ridges are arranged generally, obviously in conformity with the arrangement of the Trap system, and apparently owe their elevation to the same force which has elevated the Trap. It would therefore not be unexpected, if traces of the presence of Trap should be found in connexion with every elevation of sandstone. The clay dikes, noticed in connexion with the posterior ranges of the fourth Eastern system,

are probably such indications, and perhaps also the beds of brown fetid and black bituminous shale with limestone, in the same part of the formation.

The *Northern Subordinate Basin*, in the larger Secondary formation, includes only a single range of Trap, situated nearly in the centre of the basin, and forming a well marked curve, convex to the West. The Trap, in this basin, as has already been observed, is proportionately less extensive than in the Southern basin; the principal elevations being composed of sandstone, and forming lateral ranges to the Trap. These are most elevated towards the South, presenting there two remarkable summits (Mt. Toby and the Sugar Loaf,) flanking the Trap range, on the East and West, and considerably exceeding, in height and general magnitude, the most elevated point of the latter. This presents only one strongly marked curve, in which apparently four subordinate sections may be distinguished, marked by a less degree of curvature; namely, that part of the range on the S. East, E. of the Connecticut; that extending from the Connecticut to Deerfield river; that from Deerfield river to Fall river; and the remaining portion towards the N. East. This last section is separated, in receding order, from the next preceding, by an interposed band of sandstone; an appearance not unfrequent, under similar circumstances, in the Trap ranges of the Southern basin. The Trap, in this Northern basin, exceeds, in elevation, the sandstone fronting it, only in the third section, East of Greenfield, although of nearly equal height, in the contiguous parts of the two adjoining sections. The range commences in a low dike-like point West of Mt. Toby, and terminates in a similar low point, on the N. East, near the centre of Gill, attaining its greatest elevation, rather N. of its middle point, in reverse order to the elevation of the sandstone. The Trap has the same relations to the Secondary rocks, in the present, as in the Southern basin; being bordered on the West by sandstone, and overlaid on the East by a band of shale, behind which extends another range of sandstone. The elevations of the sand-

stone, in the present, as well as the Southern basin, apparently conform, in their arrangement, to the Trap, as if controlled by the latter.

II. The Trap System of the Smaller Secondary Formation.

The Smaller Secondary Formation occupies a small elliptical basin, included between the N. Eastern part of the range (F,) and the S. Western part of the range (G,) in the Western Primary; extending N. N. E. from six to seven miles, with an average width of less than two. The Trap, in this formation, in its relation to the sandstone, is in the opposite extreme to that of the Northern basin of the larger Secondary formation; occupying a much greater relative proportion of the extent of the formation, than even the Trap of the Southern basin of the larger formation, and apparently forming all its considerable elevations. These latter are, however, inferior in height to the elevations of the surrounding Primary. The Trap, in this formation, forms only a single range, presenting, in its whole extent, a well marked curvature, and divided, by cross valleys, into three distinct sections, succeeding each other in receding order. Of these, the Southern (1) extends from the S. E. point of the range, to a pass crossing the latter, at the road from Southbury to Roxbury; the middle (2) extends from that pass to the Pomperaug, S. of Woodbury village; while the Northern (3) includes all the remaining portion of the range. The curve of this range is apparently formed, throughout a great part of its extent, by a series of parallel ridges, overlapping each other, in a greater or less degree, and arranged, towards the opposite extremities, in reverse order; namely, in advancing order, towards the Southern, and in receding order, towards the Northern extremity. This arrangement is most remarkable, at the two extremities of the range; its middle portion, for some distance, presenting only a single line of elevations, nearly in continued order. Apparently the small extent of the basin has, as it were, compressed the range,

particularly at its extremities, and thus prevented its extension into a long continued ridge, or the formation of a gradual curve.

The range, at its Southern extremity, presents an abrupt front to the South, formed by the points of its parallel ridges, and recedes back, towards the North, at its S. E. point, where it approaches very near the Eastern border of the basin. The larger ridges, at this Southern extremity, towards its S. W. point, present each two distinct ranges, separated by a band of friable red shale, with beds of bituminous shale and limestone, containing fish impressions. The Eastern and higher of these ranges, consists of compact crystalline Trap; the lower Western, of a porous amygdaloid. The latter, in the most Western of these ridges, is underlaid by sandstone, and the same rock occurs, at the S. points of the more posterior ridges, between their amygdaloidal range, and the Trap range of the more anterior ridge. This arrangement, in the different ridges, corresponds very exactly with that along the West front of the Eastern line of elevation, in the Southern basin of the larger Secondary formation. The main Trap range, in its Southern section (1,) and the S. part of its middle section (2,) is bordered, on the East, by an apparently distinct range of a very porous chloritic and decomposable amygdaloid, forming a series of low rounded swells, generally covered with the rock in small fragments. This latter range is accompanied, at least towards its S. E. point, by bituminous shale and limestone, recently excavated for coal. Similar excavations have been made in the bands of shale, at the S. W. extremity of the main range.

The Northern section (3) rises, in strong receding order, East of the Pomperaug, in the S. part of Woodbury village, and extends N. N. E. in a group of parallel ridges, E. of that village, so arranged as to present, at their Northern extremity, a distinctly curved outline, convex to the North. These ridges rise in low points towards the South, and attain their greatest elevation towards the North. This group may be considered as divided into two parallel sections, by a deep val-

ley opening N.—S.; the Eastern being projected rather farther N. than the Western. Each of these sections presents a middle higher ridge, composed of a more compact crystalline Trap, and two lower lateral ridges, composed of a more amygdaloidal Trap, abounding at different points, in prehnite and agates. On the East, this group approaches very near the Primary, being separated only by a narrow valley, at one point of which the Primary and Trap rocks are nearly in contact.

I have previously stated that the present range is divided into three leading sections, by transverse valleys; but from a consideration of its arrangement, it may be more naturally divided into two main curves, which meet each other, in strong receding order, near the middle point of the middle section, as above described. By a reference to the map, it will be seen that the range recedes, in the S. W. part of the latter section, as if at the N. point of a curve, towards the front of a long higher ridge, abrupt to the West, and bordered in that direction, by a valley opening Southward. This last ridge forms the S. point of the Northern curve, which also includes the group East of Woodbury, or the Northern section. Each of the curves, thus limited, has a more distinct curvilinear outline, than either of the three sections, above described. The amygdaloidal hummocks, bordering the S. part of the middle section, as above noticed, thus also take their appropriate place, as the Northern termination of the amygdaloidal range, posterior to the Southern curve.

III. The Trap Dikes traversing the Primary.

These dikes have already been described, in their general characters and relations, in the introductory remarks to the general Trap system. It has there been stated, that they correspond so closely in the physical characters of their Trap, and in their arrangement, as to indicate strongly that they are a part of the same system, and derived from the same source, as the Trap, accompanying the larger Secondary formation. Four extensive dikes traverse the Primary of the State; two in

the Eastern, and two in the Western Primary, on opposite sides of the larger Secondary formation. No other point of well marked Trap has been observed by me, in connexion with the Primary, beyond the limits of the ranges of these dikes. The small dike-like veins, noticed in connexion with the Porphyritic formation (G S. 3 ζ W.,) are rather a modification of Primary Hornblende rock, than a proper Trap. The dikes, traversing the Primary, are in a reverse relation to each other, on opposite sides of the Secondary; the more N. Western dike, in the Western Primary, being the most extensive, and the more S. Eastern dike, in the Eastern Primary. These dikes range in a general N. N. Easterly direction, but present, in their course, well marked curves, which correspond, in their arrangement, to those of the Trap ranges, accompanying the Secondary. They terminate, at one of their extremities, near or on the adjoining frontier of the Secondary, and recede from it, towards their opposite extremity; the Western dikes approaching the Secondary, at their N. Eastern termination; the Eastern dikes, at their S. Western.

(W. 1.) The S. Eastern Dike, in the Western Primary, extends from a point on the Eastern border of the N. point of the Chloritic formation (A,) S. Westerly, to a point N. W. of Milford village; traversing the Chloritic formation (A,) and the Argillite (B,) and penetrating some distance into the Mica Slate formation (C.) This dike, in its N. E. part, where it crosses the Chloritic formation (A,) is scarcely interrupted, and is more largely developed than in any other part of its course, forming quite an elevated ridge, composed of a series of hummocks, arranged in a manner very similar to those of the Trap ridges, accompanying the Secondary. Generally the walls of the dike are nearly vertical, with a corresponding nearly horizontal arrangement of its columns.

The dike, in crossing this formation, pursues usually a very direct course S. S. W., but with occasional lateral shifts, sometimes exceeding the width of the dike. At its N. E. point, it bends abruptly E. N. E., soon terminating near the Eastern

border of the Chloritic formation (A,) in a direction towards the spur, on the W. front of the West Rock range, into which it is apparently continued. A smaller dike, nearly parallel to the main body of the dike, farther S., crosses the N. E. point of the latter, and extends South nearly to the Humphreysville Turnpike, along the Eastern border of the Chloritic formation. The chlorite slate, adjoining the dike, is usually altered to a considerable width, being converted from a soft green to a hard dark blue or purple slate, in some instances filled with small veins of a light yellow colour. The altered slate breaks, like the Trap, into jointed fragments. The dike, as it passes out of the Chloritic formation, becomes less elevated, and more interrupted, at least on the surface, particularly after entering the Argillite (B.) Soon after entering that formation, it projects abruptly West, N. of the Derby Turkpike, again resumes its former S. Westerly course, and still farther in that direction, towards North Orange meeting-house, again projects West, in a series of lateral shifts, when it extends S. S. W. along the E. side of the valley of Milford river, on the East border of the Mica Slate formation (C,) at least to the Milford and Derby road. Farther S. W. the dike is not observed actually in place, but N. W. of Milford village, an accumulation of blocks of a Trap, similar to that of the dike farther N. E., is extended in a line, along the E. side of the Mica Slate range (C,) West of Milford river, apparently indicating the passage of the dike in that direction. Numerous blocks of a similar Trap are found in the diluvium, N. W. of Milford village. The dike, where it crosses the Argillite (B,) is usually little elevated, and more frequently interrupted, than in connexion with the Chlorite Slate (A.) After entering the Mica Slate (C,) it merely appears on a level with the surface, where it is sometimes traceable only in a line of dislocated blocks, conformable to the range of the dike.

By recurring to the map, it will be seen that the dike presents a general curve, convex to the S. E., but considered in its subordinate parts, it apparently consists of a series of curves,

with their convexity towards the West, marked by its different projections Westward, the curves commencing towards the S. W. and receding East, at the projections above referred to. The argillite and mica slate, adjoining the dike, are comparatively little altered. The Trap of this dike is generally dark grey, and fine-grained; finer grained and more compact, indeed, than that of the ranges, accompanying the Secondary, generally. It usually breaks in larger blocks, particularly in the centre of the dike. Its lateral, more wacky portions, are often very small fragmentary. The dike in the chlorite slate is usually 4—6 rods in width; farther S. W. it is usually narrower, its size increasing as it approaches the Secondary.

(W. 2.) The N. Western Dike, in the Western Primary, is much more extended than the preceding, though rarely exceeding it in width. It extends from the W. side of Compo Creek, near its mouth, in the S. W. corner of Fairfield, N. Easterly, with several lateral shifts and apparent interruptions, to a point in the S. E. corner of Wolcott, nearly W. of the S. W. point of the fourth Eastern main curve, in the Trap of the larger Secondary formation, and less than a mile from the Eastern border of the Western Primary. This dike has thus apparently the same relation to that curve of the Trap system of the larger Secondary formation, that the preceding dike has to the Southern section of the Western line of elevation, in the same formation. This dike, like the preceding, presents, in its whole extent, a general curve, convex to the East, while in its subordinate parts, its arrangement apparently resembles that of the preceding dike, consisting of a series of ranges, receding to the East, from its S. W. extremity, and in several instances, with a well marked curve, convex towards the West. The Trap of this dike is partly coarse-grained, and in larger blocks, resembling that of the larger Eastern dike, and partly fine-grained and smaller fragmentary. In some instances, the coarser grained is smaller fragmentary, and the finer grained in larger blocks. The fine-grained variety is more frequent in the N. part of the dike, in some of the smaller branches of which it

resembles a dark blue compact wacke. The short range, at its N. E. extremity, consists of a fine-grained lighter grey variety, approaching that of the smaller dike, relative to it, in the Eastern Primary. In some instances, the dike is divided longitudinally into two portions, one coarser, and the other finer grained; as at the S. point of the section of the dike, between the Housatonic and Naugatuck, where the Eastern half of the dike is composed of a finer grained Trap, breaking in large regular blocks, and the Western half of a coarser grained, smaller fragmentary variety.

Commencing at its S. W. point, the dike first extends N. N. Easterly, along the West side of Compo Creek, then recedes East, across the latter, and after having been concealed for some distance by diluvium, crosses the New York Turnpike in the same N. N. Easterly direction, on the summit of the ridge W. of Sasco Creek. It then recedes again to a greater distance S. E., and re-appears on the N. shore of a small bay, on the West side of the mouth of Mill river, whence it extends N. N. E. through the village of Southport, nearly to the New York Turnpike. An excavation in the dike, at Southport Landing, very strikingly exhibits its indurating effects on the adjoining Micaceous Gneiss (D 7.) After an interruption, by the plain East of Mill river, it re-appears near the church (N. W. of Fairfield village,) nearly E. N. E. from its last termination, whence it extends E. N. Easterly along the summit of the ridge, N. of Fairfield village, and is continued in the same general direction, to the Newtown Turnpike, about two miles N. of Bridgeport. Throughout that part of its extent, already described, it apparently forms a curve, convex to the N., with its chord directed nearly E. N. E. The dike is very slightly interrupted for about one half the distance from the church (Fairfield) to the Newtown Turnpike, but for the remainder of the distance, is more interrupted or concealed. Just East of the Turnpike, last noticed, it assumes a N. Easterly direction, in which it continues, through Trumbull and Huntington, to the Housatonic, 1—2 miles above Derby, bear-

ing more N. N. Easterly as it advances towards the North. At the passage of the Newtown Turnpike it apparently curves N. Easterly, with a convexity towards the S. E., contrary to the more general direction of the subordinate parts of the range. From that Turnpike to a point not far N. E. of the Pequanock, in Trumbull, the dike forms an almost uninterrupted range, presenting a series of elevations, arranged in a manner very similar to those of the Trap ranges, traversing the Secondary. The dike is intersected by the Housatonic Rail Road, on the W. side of the Pequanock, and on the E. side of that stream, rises in a singular detached elevation (Pulpit Rock,) very strikingly resembling some of the shorter more abrupt elevations connected with the Secondary. Farther N. E. to the Housatonic, the dike is more interrupted, as will be seen by reference to the accompanying map. The dike passes through the Eastern part of Huntington village, and appears just N. E. of the same, by the road leading to Derby, where it has strikingly indurated the porphyritic and sub-porphyritic rocks of (D 10,) adjoining it. From this point, it is apparently interrupted or concealed, to within a few rods of the S. bank of the Housatonic, where it just appears in a ravine descending the hill, S. of the river.

North of the Housatonic, the dike recommences at the S. point of a long ridge, extending N. N. E. nearly to the Naugatuck, along the E. side of the summit of which it is continued, with slight interruption, throughout its whole extent. At the S. point of the ridge, it rises abruptly, in a series of steps, formed by its nearly horizontal columns, and for some distance North, exhibits a series of detached castellated elevations, presenting a peculiar appearance at a distance. At the N. point of this ridge, it terminates in several nearly parallel small dikes (no less than nine of which were observed,) separated by highly indurated bands of Porphyritic and sub-porphyritic Gneiss (D 10.) The dike is apparently interrupted, at the passage of the Naugatuck, but re-appears again, in receding order, on the E. side of the road from Derby to Humphreysville. It

then extends, in a direction more nearly North, through the E. part of Humphreysville, to the S. bank of Bladen's Brook, near its entrance into the Naugatuck. In this part of its course it presents striking instances of its indurating effects on the adjoining rocks, particularly Granitic Gneiss and Granite. Seams of radiated zeolite are observed between it and the latter rock adjoining, just S. of Humphreysville. For a considerable distance (2—3 miles) N. of Bladen's Brook, no appearances of the dike have been observed by me. It then re-appears, on the N. branch of that stream, S. of the road leading West from Bethany meeting-house. It there curves distinctly East, at its Southern extremity, (crossing the bed of the brook, which is precipitated over it in a small cascade,) and in a direction S. S. E. from that point, a very small dike was observed by me, traversing the Porphyritic Gneiss (D 11) N. N. Easterly. The dike apparently recedes to this point, nearly E. N. E. from its former termination, S. of Bladen's Brook, and then advances to the point on the N. branch of that stream, above noticed. From this latter point, it is continued, with no great interruption, first advancing N. N. W., and then receding N. N. E., to a point just S. of the Litchfield Turnpike, about a mile S. E. of Straitsville. This latter range presents a distinct curve, convex to the West, and nearly conforming to the S. part of the Northern curve (Western line—Southern section,) on the Western border of the Secondary. Farther North, the dike has not been distinctly traced by me, through a long interval, in Prospect, although strong indications of its presence occur in the valley East of the Micaceous formation (E,) not far S. of the limestone locality, noticed in connexion with the Porphyritic formation (D.) The dike at last re-appears, in a short range, about N. by E. from the point, last noticed, extending less than half a mile N. N. Easterly (crossing the Meriden and Waterbury Turnpike,) in the line of a band of garnetiferous Hornblende, farther North, adjoining the formation (E) on the West. This range, as already noticed, is situated nearly West of the S. point of the Fourth Eastern Main Curve, in the lar-

ger Secondary formation. No appearance of the dike has been observed by me, farther North.

(E. 1.) The S. Eastern (larger) Dike, in the Eastern Primary, commences on the shore of Branford Harbour, within the limits of the tide, and extends N. Easterly, entirely across the State, into the town of Holland (Mass.,) and is probably connected with the dike at Fiskdale (West of Sturbridge,) and perhaps with that in Rutland (N. W. of Worcester,) both of which are in its general line of direction, continued.* The length of this dike, within the limits of the State, cannot be less than seventy miles, including its windings. It presents, in its course, several well marked curves, convex to the East, the connexion of which with the different curves of the Eastern line of elevation, in the Trap system of the larger Secondary formation, has already been indicated. This dike, like the others, does not form one uninterrupted range, but consists of more or less detached elevations, succeeding each other, by lateral shifts, in the different orders of succession, noticed in the arrangement of the Trap ridges, traversing the Secondary. The larger curves of the dike also succeed each other, in similar order. The Trap of this dike is generally coarser grained than that of the other dikes, and resembles, in that respect, some of the coarser varieties of the Trap, accompanying the Secondary. It generally breaks in large square blocks, and is little decomposable. In numerous localities, a still coarser, very decomposable variety, similar to that at the East end of Mt. Carmel, and that of the ridge, called Tremont, East of Wallingford, occurs on the sides of the dike, particularly on the Eastern side, readily disintegrating into a coarse gravel, and occasionally into concentrically cleaving balls. Another appearance frequently occurs in this dike, rarely observed by me in other dikes or ranges of Trap, namely, a division into

* Specimens have been shown me, from a dike on Lake Winnipiseogee (N. H.,) which strikingly resemble, in physical character, the more usual variety of the present dike. By reference to a map, it will be readily perceived that the former dike is in the general direction of the latter.

thin, firmly cemented plates, by longitudinal lines of cleavage, parallel to the walls of the dike, giving to the rock an appearance of stratification. This dike exhibits striking effects of alteration on the adjoining rock, and usually a thick band of dark blue wacke, adjacent to the latter. The dike is generally in a nearly vertical position, in the including rock, but occasionally is found in an inclined position, apparently interposed between the strata of the latter. Its usual width varies little from that of the larger portions of the two Western dikes.

The dike, at the point where it apparently commences, on the shore of Branford Harbour, is quite narrow, and in an inclined position, dipping West, with a distinct curvature in that direction, towards the South. A point of land, West of the Harbour, lies in the line of its direction, continued, but no traces of the dike have been observed on it. The commencement of the dike, as above stated, is E. S. E. from the S. point of the Pond Ridge (first Eastern main curve in the Secondary,) towards which it is apparently deflected. The dike extends N. Easterly, along the course of Branford river, soon assuming its ordinary width, and occasionally interrupted, to a point E. S. E. from the N. E. point of the Pond Ridge, forming its first main curve, corresponding to the first Eastern main curve in the Secondary. A second curve commences, near the N. point of the latter, in receding order, and sweeps around, East of North Branford village, and of the S. W. point of Toket Mountain (second Eastern main curve,) near the Western border of the Primary, to a point S. E. of the S. point of the Southern posterior range of Toket Mountain. Another strongly marked curve succeeds, in advancing order, terminating E. S. E. from the N. E. point of the same posterior range. The dike then continues N. Easterly, with little flexure, to a point S. E. of the S. W. point of Quonipaug Mountain (the Northern posterior range of Toket Mountain,) when it forms another strongly marked curve, terminating E. S. E. of the N. E. point of the latter posterior range, at the summit of the ascent, on the immediate Western border of the Eastern Pri-

mary. That part of the dike, from the point E. S. E. of the N. E. point of the Pond Ridge, to the point last noticed, may be considered as forming one extensive curve, (to which those above described, are subordinate,) corresponding to the main curve of Toket Mountain, in the Secondary. The dike, in this part of its course, is continued in a line, very near the Western border of the Eastern Primary, to which it is also nearly parallel. It usually forms there a high mountain-like ridge, hardly inferior to the second class of Trap ridges in the larger Secondary formation, and arranged in a manner, often strikingly conformable to the latter. Like other dikes, however, both in the Secondary and Primary, the usual nearly horizontal position of its columns, perpendicular to its walls, gives a peculiar tabular form to its elevations, different from those of the inclined ridges in the Secondary, but not unlike those of the larger dikes in the latter, such as that of Mill Rock. From the same circumstance, also, where it continues in the same uniform direction, with slight lateral shifts, its hummocks are usually separated by more directly transverse depressions.

At the point last noticed, the dike bends abruptly East, and is continued in that direction, almost directly across the strata of the including rocks, and with slight interruption, to a point a short distance E. of the Hammonassett. It then advances strongly to the S. E., with an apparent interruption of nearly half a mile, when it is continued E. N. E., gradually curving around to N. N. E., in an almost uninterrupted range, to a point more than a mile N. of the S. line of Haddam. It there bends distinctly West, and terminates in an isolated rock, in the valley of the E. branch of Higganum river. The dike, in its progress Easterly, usually forms a ridge, little elevated above the surface of the including rocks, but as it turns Northerly, presents a high mountain-like ridge, similar in height and arrangement, to that in its preceding main curve. After an apparent interruption of nearly a mile, the dike again rises on the West side of the E. branch of Higganum river, and soon

crossing it, extends N. N. E. along the summit of a ridge, E. of the same, (Cedar Hill,) descending Northerly to the Connecticut at Higganum landing. On the descent to the river, N. of the Haddam Turnpike, it divides among the including rocks (granitic gneiss B 1,) in the same manner as has been noticed in the N. Western dike (Western Primary.) The dike appears, opposite, on the E. side of the Connecticut, in the face of a high ledge of the granitic gneiss of (B 1,) and is thence continued N. Easterly across that formation, and the Anthophyllitic range (B 2,) into the Micaceous range with granite (C 3½.) Towards the North, it recedes twice distinctly to the West, terminating its present main curve, at a point E. N. E. from Middle Haddam meeting-house. The very extensive curve, from this point to that E. S. E. of Quonipaug Mountain, corresponds to the third Eastern main curve (in the Secondary,) in the manner already stated in connexion with that range.

The dike commences a new curve, at the N. E. point of the preceding, in a manner, in some respects, unlike any arrangement previously noticed. The new curve begins at a point some distance West of the N. point of the preceding, crossing the latter in an Easterly direction, nearly at right angles; the two dikes, at their point of approach, being nearly in contact. It continues in this Easterly direction, across the outlet of East Hampton Pond, and then after a short interruption or concealment by diluvium, curves around N. Easterly, extending in an uninterrupted range, along the East side of the valley of that stream, to the West side of a high diluvial ridge, S. of East Hampton meeting-house. It is apparently concealed in crossing that ridge, but appears on its E. side, S. of the Colchester Turnpike, and nearly East of the point last noticed, and curving around from E. N. E. to N. N. E., extends along the E. side of the ridge, nearly to its N. point, terminating in a narrow dike, partly inclined between the strata, and abounding unusually in the dark blue wacke, already referred to. The dike then shifts or recedes largely to the West, to a ridge in a line farther West than the preceding, along which it is con-

tinued N. Easterly, nearly to Dickenson's brook, S. of the Marlborough Turnpike. It then bends E. N. E. across a high ridge S. W. of Marlborough meeting-house, and sweeping around, not far E. of the latter, is continued N. Easterly, to a point a short distance West of the West branch of Farm river, S. W. of Gilead. Here it forms a new curve, commencing in a similar manner with that at Middle Haddam, but bending around at its S. W. extremity, into a line parallel to the N. E. point of the preceding. This new curve extends E. N. E. to the W. branch of Farm river, from which point to Andover village, in a N. E. direction, only indistinct traces of the dike have been observed by me, but from the numerous blocks of Trap, resembling that of this dike, found East of its line, in Gilead and Hebron, it probably extends through that interval, mostly concealed by the diluvium, with which that part of the country is, in a great measure, covered.

At Andover, the dike re-appears at the Baptist meeting-house, S. of Hop river, in a line of large blocks in place, directed N. Easterly, and farther N. E. on the North side of that stream, commences a new curve, whence it extends, with little interruption, E. N. Easterly, to the West side of Coventry Pond. It then crosses the high ridge, E. of that pond, curving around N. Easterly, and E. of the Willimantic is continued in that direction, nearly to the Tolland and Mansfield Turnpike, when it bears N. N. E. to Willington village, passing directly beneath the meeting-house, and extending in the same direction, nearly a mile farther North, along the East side of the high ridge, extending N. from that village. In the interval between the Willimantic and Willington village, the dike is frequently interrupted, or concealed by diluvium, and throughout the whole distance from Andover, although preserving its usual width, is rarely much elevated above the adjoining surface. North of the termination, last noticed, it shifts to the West, to the summit of the high ridge, N. of Willington village, whence it may be traced, in a general N. N. E. direction, with occasional interruptions of considerable extent,

through the West part of Union, to the North line of the State, where it terminates in a very narrow point, in a ledge of the micaceous gneiss of (D.) In the same direction N. N. E., across the valley of a Western branch of the Quinabaug, in Holland (Mass.,) a line of blocks extends for some distance, as if in place, indicating the presence of the dike. This is the last point, to which I have traced the dike in its progress N. Easterly.

That part of the dike, N. of the flexure at Middle Haddam, may be regarded as forming one extensive curve, corresponding to the fourth main curve, in the Secondary; its S. W. point being situated about E. by S. from the S. W. point of the latter. This may be divided into three subordinate curves, each of which presents a series of still smaller curves, like the larger sections of the ranges accompanying the Secondary. The first of these subordinate curves, extending from the bend at Middle Haddam, to that S. W. of Gilead, corresponds to the Southern division of the Southern section of the fourth Eastern main range, in the Secondary; namely, that S. of Cook's Gap. The second curve, from the latter bend, (which is situated nearly East of Cook's Gap, as well as of the S. E. point of the most Eastern posterior range, corresponding to the Southern section, just referred to,) to the bend at Andover, corresponds to the Northern division of the same Southern section, namely, that from Cook's Gap to Talcott Mountain. The third curve, from the bend at Andover (nearly East of the S. point of Talcott Mountain,) to the N. line of the State, in like manner corresponds to the Northern section of the fourth Eastern main curve in the Secondary, namely, that from the S. point of Talcott Mountain, Northward.

(E. 2.) The N. Western Dike, in the Eastern Primary, is of less extent, within the limits explored by me, than the S. Eastern, but is little inferior to it in general magnitude. It rarely, however, forms such elevated ridges, as frequently occur in the latter, being more usually little elevated above the surface of the including rocks, and arranged in large horizontal steps

or columns. The Trap of this dike differs, in its peculiar physical characters, from that of any other range of Trap, connected either with the Primary or Secondary, and preserves a great degree of uniformity throughout its whole extent. It is most nearly allied, as already stated, to that of the short range at the Northern extremity of the N. Western dike, in the Western Primary. It is usually very fine-grained and compact, with small rounded nodules of a peculiar greenish felspar, not unfrequently imbedded. Its weathered surface is often covered with a thin coat of a light brick red colour, from the presence of minute pyrites, and from the same cause the outer part of its prismatic fragments is occupied by a very even band of a dark grey colour, contrasting singularly with the original lighter grey colour of the interior. This dike commences distinctly in place, a short distance S. of Vernon village (E. of the Hartford Turnpike;) but more or less apparent indications of it may be traced South from that point, in a line near the Western border of the Primary, nearly to the Ashford Turnpike, E. of Manchester village. The dike passes through the S. W. part of Vernon village, whence it is continued in a slightly interrupted range, to within half a mile of the Hockanum, at Rock Factory village. From that point to the valley of Broad Brook, N. E. of Ellington village, it appears occasionally in ranges of greater or less extent, but is apparently, in this part of its course, chiefly covered with diluvium. Thus far, the dike ranges in a very direct line, N. by E., nearly parallel to, and at a short distance from the Western border of the Primary. On the North side of the valley last mentioned, the dike advances East to the summit of the high plateau of (C 2 ^{2},) along which it again extends in nearly the same direction as before, to the S. E. point of Durfee's Mountain (S. E. of Somers village.) Here it commences a well marked curve, convex to the East, first bearing E. N. E., but soon turning N. Easterly, in which direction it is continued to the Somers and Stafford county road, near the middle of the range (C 2 ^{2}.) It then extends in a similar N. Easterly

direction, (twice advancing Eastward, and thus forming two subordinate ranges,) to the Western border of the Mica Slate range (C 3,) at the N. line of the State. It then advances abruptly to the W. side of the high ridge, formed by that range, along which it can be traced only a short distance N. N. E.; being apparently concealed, farther North, by diluvium, and perhaps interrupted in crossing the summit of that range. It reappears again, on the East side of the latter, in the same N. N. E. direction, and is continued thence N. N. E. within the limits of the Granitic range (C 4,) at least to a point N. of Monson village. Its course is indistinctly marked, until it reaches the granitic quarry, N. N. W. of that village, where it appears as a wide but low dike, apparently curving in a more N. Easterly direction. At the point where I left it, it was in full force, indicating an extensive range, farther N. E., and is probably connected with the dikes observed by Prof. Hitchcock, in the N. W. part of Worcester county. The present dike commences, on the South, at a point E. by N. from the S. point of Talcott Mountain, and apparently corresponds with the Northern section of the fourth Eastern main curve, in the Secondary. A very small dike of Trap was observed by me, in a single point, near the Western border of the Eastern Primary, S. E. of Granby (Mass.,) perhaps connected in its range with the dike noticed by Prof. Hitchcock in Pelham (Mass.)

The Secondary Rocks.

These occupy two distinct basins (formations) of very unequal magnitude, entirely surrounded by Primary rocks, and closely resembling each other in character. The larger of these formations extends from Morris' Cove, on the East side of New Haven Harbour, on the South, to the North end of Northfield village (Mass.,) on the North, a distance of nearly 80 miles. Its greatest width, near the central part of the basin, exceeds 20 miles. This basin is entirely surrounded by Primary rocks, except at New Haven Harbour, where, however, Primary rocks form the two points on the opposite sides

of the entrance of the latter. The Primary rocks, on the opposite sides of the basin, as already stated, present no direct analogy, but form parts of two distinct systems. At least this is true of the Primary rocks within the limits of this State, and for some distance farther North. The smaller Secondary basin extends six to seven miles from South to North, and at its widest point scarcely exceeds two miles in breadth, and is about equally included in the towns of Woodbury and Southbury. It forms a small isolated tract, nearly in the centre of that part of the Western Primary, within the limits of the State, and nearly 15 miles West of the Western border of the larger Secondary formation. It is included between the N. E. part of the range (F,) on the East, and the S. W. part of the Mica Slate range (G,) on the West.

The Secondary rocks of the two basins consist of Sandstones or Conglomerates and Shales, generally red, but occasionally of different colours. The Sandstones vary from the finest grain, passing into the shales, to the coarsest conglomerates; the latter sometimes containing even small bowlders imbedded. One of these I have observed in North Guilford, on the immediate Eastern border of the larger Secondary formation, two to three feet in diameter, consisting of a white felspathic granitic gneiss, occurring in subordinate beds, in the Micaceous range (B 3,) on the Western border of the Eastern Primary, adjoining. The coarser grained sandstones are usually thick bedded, and sometimes the finer grained are equally so; but the latter more usually are thinner and more schistose. The Shales are generally argillaceous, and compactly fine-grained; sometimes more or less micaceous, and occasionally more siliceous, passing into the finer and more schistose sandstones. Both the Sandstones and Shales are occasionally calcareous; indeed a soft, thinly schistose variety, imbedded in the coarser sandstone, posterior to the Trap range (W. S. II,) in the larger Secondary formation, may be considered a marl slate. Nodules of a light bluish compact limestone sometimes occur in the coarser sandstones, and seams of brown spar are frequent

in the shales. Some of the sandstones, when decomposing on the surface, possess a fertilizing property, probably from the lime they contain. Two varieties of limestone occur in these basins; one interstratified in the shales, usually bituminous, but occasionally light blue, compact and fetid, and in both instances, valuable as a material for cement; the other, light or dark grey, also compact and fetid, apparently interposed between amygdaloid and shale, and capable of furnishing a good lime (as that of Northford.) The latter variety has been already noticed in connexion with the anterior amygdaloidal range, immediately fronting a part of the Eastern main curve in the larger Secondary formation. Beds of black bituminous, and brown, occasionally fetid shale, are not unfrequent in the ordinary red shale. Beds of the former kind occasionally occur also in the sandstone in the Eastern part of the larger secondary formation. Thin parallel seams of coal or bitumen, sometimes occur in the bituminous shale, which also contains impressions of fish and vegetables.* Seams of bitumen are occasionally observed in cross fissures, in different localities, traversing the ordinary red shale. The Sandstones of both these formations are obviously formed of fragments of Primary rocks, similar to those of the adjoining Primary formations, and in most instances, the larger fragments, particularly in the coarser conglomerate along the Eastern border of the larger Secondary formation, can be distinctly traced to different varieties in the adjoining Primary, frequently in the immediate vicinity. These facts satisfactorily indicate that these Secondary formations were formed from the debris of the Primary rocks, part of which, at least, might have occupied the site of these Secondary formations.

The Sandstones and Shales of the different Secondary ba-

* It was my intention to have particularly investigated the organic remains found in the two Secondary formations of the State, after I had completed my general plan of survey, but the necessary means of defraying my expenses even, having been then withheld from me, I shall confine myself in this report, to an enumeration of the localities in which such remains have been noticed.

sins, have an obvious connexion with the Trap of those basins, both in their distribution, and in the arrangement of their elevations. These rocks are not distributed in regular parallel superimposed ranges, but their limits are distinctly controlled by the arrangement of the Trap systems. Thus in the larger Southern basin, in the Eastern (larger) Secondary formation, the country West of the main Eastern line of elevation, or of its approximate anterior range, when present, is occupied by Sandstone, while the country East of the same line of elevation, for a greater or less width, and the space between it and its anterior range, above referred to, are occupied by Shale, E. of which extends another range of Sandstone, generally, on the immediate border of the Eastern Primary, a coarse conglomerate. In the smaller Northern basin of the same formation, Sandstone fronts the Trap range on the West; Shale immediately borders the latter, on the East, at least in its middle part; while another range of Sandstone extends along the E. side of the basin, also a coarse conglomerate, adjoining the Primary. In the smaller Secondary formation, Sandstone also fronts the Trap range, on the West, while Shale is included between it and its anterior and posterior ranges of amygdaloid. The Sandstone, if it exists on the E. border of that basin, so far as I have observed, is there concealed by diluvium. From these statements, the Shale apparently has a more intimate connexion with the Trap, than the Sandstone, and even in those districts, where the Trap is more entirely connected with Sandstone, points of Shale sometimes occur, in immediate connexion with it, usually similar in character to that between the Trap and amygdaloid ranges. Such instances occur at Mill, Pine and West Rocks, and in connexion with the Posterior range (P. 1 W. S. II,) in North Hamden. The Sandstone of the two ranges, East and West of the Shale, in the larger Secondary formation, presents, in many respects, a peculiar character in each; and that in the smaller Secondary formation, has also its peculiar character. The coarse conglomerate, composed of angular fragments of the adjoining Primary rocks,

little altered, and often slightly cemented, is apparently confined to the Eastern border of the two basins, in the larger Secondary formation; for although a coarse conglomerate occasionally occurs in the Western part of those basins, yet its fragments are usually more abraded, and less easily referable to the adjoining Primary formations.

I shall not here attempt to point out any connexion between the Sandstone of the two Secondary formations, in this State, and any member of the great European series of Secondary formations, or of the series occupying the great Mississippi basin. Its physical characters, its connected limestones, and its organic remains, apparently indicate a more peculiar relation to the New Red Sandstone, but without an opportunity for an exact investigation of its organic remains, I would not venture even to suggest such a connexion. I cannot, however, avoid the impression, that these formations are of a local isolated character, forming a complete system in themselves, and apparently independent of any more extensive formation. The remarkable relation of the different members of these formations, in their distribution, to the Trap accompanying them, would seem to indicate an immediate connexion, in the mode and period of formation, of the two classes of rocks; the Secondary basins having been apparently the centre or focus of an igneous action, which has produced the Trap, both accompanying the Secondary and Primary, and the Sandstone, in part at least, having been formed from the debris of the Primary rocks, disintegrated by the same igneous agency, and consolidated and discoloured by the heat attending it. The elevations of the Sandstone, in these Secondary formations, also correspond, in a striking manner, in their arrangement, with the arrangement of the Trap systems, thus indicating that they were due to the same elevating force. The general direction of the strata of the Sandstone, where it is not particularly influenced by the Trap, is N. N. E., and the same is also the medial direction of the Trap ranges. The general dip of the Sandstone is East, conformable to that of the inclined

ridges of Trap. A particular comparison of the different elevations of the Sandstone, with those of the Trap, would exhibit a similar conformity. A minute detail of the arrangement of these elevations would exceed the limits of this report. They are, however, represented sufficiently on the accompanying map, to render the statement, just given, at least probable.

The elevations of the Sandstone, in the Southern basin of the larger Secondary formation, may be divided into two ranges, corresponding to the two lines of elevation of the Trap, and separated by a valley or depression, continued throughout their whole extent. This corresponds with the valley of the Quinipiack, in its Southern part, and farther North, with the level, along which extends the line of the Farmington Canal. The Southern part of this valley, between the first, second, and the South part of the third Eastern Trap systems, and the Southern section of the Western line of elevation, extending from New Haven Harbour to the S. W. part of Meriden, is continued nearly directly North, in the valley, already noticed, between the N. part of the third, and the Eastern section of the posterior ranges of the fourth Eastern system, on the East, and the Western section of the posterior ranges of the latter system, on the West. The main valley, separating the E. and W. lines of elevation, as it bends West around the S. front of the fourth Eastern system, forms only a narrow pass through a range of Sandstone, extending N. from the N. E. point of the Mt. Carmel range, to the S. front of that system; but the arrangement of the ridges there satisfactorily indicates that this pass was caused by the original conformation of the surface, and not by any posterior accidental disruption. The Sandstone ridge, N. of the pass, is obviously conformed to the S. front of the fourth system, and connected in range, with a series of isolated ridges, each in themselves directed N. N. E., but forming, in the whole, a line of elevations, extending West—East, in front of the South point of the fourth system, and of the advanced part of the third (Lamentation Mountain;)

while the ridge, S. of the pass, is at the N. point of the Sandstone range, already noticed, extending N. from the Mt. Carmel range, on the West side of the Quinipiack valley. But even this latter range, at its N. point, turns West, along the N. side of the basin of Broad Swamp, as if there conforming to the South front of the fourth Eastern system. In some instances, where the ranges of Sandstone are more remote from those of the Trap, they still present an arrangement, strikingly conformable to that of the Trap ranges. Thus a range or group of Sandstone ridges, N. E. of Durham, presents a well-marked curvature, posterior and conformable to the posterior range (P. 2 E. III,) West of Durham. Another range of Sandstone, extending along the Eastern border of the larger Secondary formation, East of the fourth Eastern system, presents a similar conformity to that system, although some miles distant from any member of it. Where the Trap ranges are directed Northerly, the Sandstone ridges generally range parallel to them, as lateral appendages; but where the former extend from East to West, the latter are thrown up opposite, and usually in front of them, either conforming directly to them in range, and dipping towards them, or forming long ridges, in the usual N. N. E. direction, and with the usual Eastern dip of the Sandstone. The former of these modes of arrangement usually extends to no great distance from the Trap ranges. The latter occurs, in some instances, where the dike-like character of the Trap range is distinctly obvious. In some instances, where the Trap range abruptly changes its course from a Northerly to an Easterly direction, a ridge of Sandstone is continued in the direction of the latter, before its change, apparently indicating a continuation of its elevating force, in the original direction. A more particular detail of the arrangement of the Sandstone, in the different Secondary basins, will be given in connexion with a local description of the different sections of each.

The Secondary rocks of the Southern basin, in the larger Secondary formation, present, as has already been stated, three

distinct sections or ranges; namely, a Western Sandstone, a Middle Shale, and an Eastern Sandstone range.

(W.) The Western Sandstone range occupies the space between the Western Primary and the Eastern main Trap range, extending from New Haven Harbour, and the Granitic range (A 1 E.,) on the South, around the N. front of the Northern limb of the fourth Eastern main Trap range, and is perhaps connected, on the North, with the corresponding Western Sandstone range, in the Northern basin of the same formation. It generally immediately underlies or borders, on the West, the main Trap range, or its anterior amygdaloidal range, where that exists, as in the third, and S. section of the fourth main range; although sometimes a band of friable shale is interposed between it and the Trap or amygdaloid. It extends, in this manner, around the whole front of the fourth main range, and enters the wide valley, between the S. E. point of the same, and the West front of the third main range, at Lamentation Mountain, along the West side of which elevation it extends for nearly half its length, while the Middle Shale extends S. along the back of the S. E. part of the fourth main range, the two being separated by a deep swamp basin, North of Beaver Pond. It fronts the anterior amygdaloidal range of the third system, N. of the central pass in the main range, but incloses the anterior range S. of that pass; being there separated from the Trap of the main range, only by a band of shale underlying the latter. In the same manner, it immediately fronts the main range of the second and third systems; only a band of friable shale, with beds of a very fine-grained sandstone, being interposed, at least in part, between it and the Trap. The Western line of elevation of the Trap is entirely included within the limits of the present section, although in some instances, as already observed, a thin band of friable shale there adjoins the Trap. This section may be subdivided into three local divisions; namely, two South of the S. W. point of the fourth Eastern system, at the Hanging Hills, one East, and

the other West of the Quinipiack, and a third, including all that part of the section, West of the fourth Eastern system.

In the S. Eastern division (1,) the Sandstone adjoining the Eastern main Trap range, for a considerable width, is less coarse-grained and decomposable, and of a more uniform reddish colour, and in many instances, as at East Haven, from its grain, thickness and firmness, is well suited for quarrying. More remote from the main Eastern Trap range, including the sandstone along the East side of the Quinipiack valley, it is coarser grained, and usually very decomposable. It is there also more or less variegated with spots, sometimes of large size, of a greenish, bluish, or ash colour, apparently indicating an affinity to the variegated sandstone (*Bunter Sandstein*,) or New Red Sandstone, of Werner. It is this variety, more particularly, which is, at times, distinctly calcareous, and which also includes nodules of a light grey compact limestone. The less variegated and decomposable variety may be considered as occupying the sandstone ridges, connected with the anterior ranges of the first Eastern system, those included within the anterior ranges of the second, and a band of a certain width, increasing toward the North, along the West side of the exterior anterior range of that system, and of the interior anterior range of the third, as well as of the corresponding anterior range, at the S. point of the fourth system. The Sandstone of this variety is usually rather coarse-grained, but occasionally beds occur of a uniform fine grain, and dark red colour, such as might form a valuable freestone. These, however, are usually of too small extent, and too much intermingled with a coarser, often more schistose variety, apparently to be worked to advantage. These beds are more particularly frequent in the N. part of the present division, adjoining the S. E. point of the fourth system. In that part of the present division, connected with the first and second Eastern systems, some peculiar varieties occur, particularly in immediate connexion with the Trap ranges. Thus in the dike ridge (A. 3 ‡ E. 1,) a red felspar abounds in the Sandstone, which where indurated,

adjoining the dikes, not a little resembles a red felspathic granite or porphyry. In connexion with other anterior ridges of the same Trap system, a variety of indurated sandstone occurs, generally breaking in rather thin tile-like fragments, of a bluish ash or light purple colour, more or less porous, and with a peculiar enamelled aspect to its fracture; somewhat resembling a trachyte. In the valley of Farm river, between the main range and interior anterior range of the second system, a peculiar thick bedded, somewhat indurated variety of sandstone is observed, with a dark purple ground, variegated, in small spots, with different colours, particularly blue and green, presenting often an elegant appearance. This variety apparently overlies the amygdaloidal conglomerate, on the back of the anterior range in question. Farther S., near the West front of the second main range, a short low ridge occurs, of a rather coarse-grained, nearly white, granite-like sandstone, composed of white felspar and mica, and bluish white quartz, apparently little altered.

The S. E. division of the Western Sandstone corresponds, in its elevations, to the Eastern line of elevation in the Trap system; although, along its Western border, it resembles the S. W. division, in the character of its sandstone. The Sandstone, connected with the anterior ranges of the first system, forms, with those, a general elevation, corresponding, in its outline, to that of the Trap ranges, and entirely surrounded by a connected series of valleys, of nearly uniform level. The Sandstone, corresponding to the second and third systems, forms, in its Southern part, a range of elevations, anterior and conformable to the Trap ranges, appearing as an accompanying outwork. Towards the North, it presents a series of high rounded ridges, already alluded to, of greater elevation than the Sandstone ridges farther South, extending in a line East—West, opposite the S. points of Lamentation Mountain, and of the Hanging Hills, exhibiting an advance in that direction, corresponding to that in the main Trap ranges.

The S. W. division (2) of the Western Sandstone is almost

entirely occupied by the coarse, decomposable and variegated variety, above noticed. Less decomposable varieties occasionally occur, usually in immediate connexion with the Trap ranges, some of which are well fitted for quarrying. The more common variety usually decomposes speedily, when exposed to the atmosphere, forming a coarse gravel, and in some instances, as at the excavation of the Hartford and New Haven Rail Road, at Holt's Hill (Meriden,) causes, during its decomposition, an increased vegetation adjoining its fragments; probably from the lime it contains. In a coarse decomposable sandstone, traversed by a ravine, on the Middle Turnpike, W. of Wallingford, long cylindrical nodules or concretions, of a light ash-coloured compact limestone, were observed, usually somewhat contorted, and breaking in fragments, by joints, somewhat resembling those of basalt. A thin bed of a fine-grained red sandstone was observed, in the excavation at Holt's Hill, apparently entirely composed of similar, but smaller cylindric concretions, breaking in the same basaltiform fragments. In the N. W. part of the present division, in Cheshire, beds occur, in the common coarse sandstone, of a thinly schistose, fine-grained argillaceous sandstone or shale, very decomposable, and also in some degree calcareous, forming a variety of marl slate. The indurated Sandstones, adjoining the Trap ranges, are usually coarse-grained and light grey, sometimes nearly white, and resembling the granitic sandstone, in front of the second Eastern main range, but usually harder and less micaceous. Such sandstones occur in connexion with the W. part of Mill Rock, the range of West Rock, both on its E. and W. sides, and the posterior ridge (P. 1 W. S. II,) in North Hamden. Traces of copper are found in this sandstone, in connexion with the latter ridge, and with the range of West Rock, at least posteriorly. A rather coarse light reddish grey, undecomposable sandstone, well fitted for quarrying, is found on the East side of the elevation, immediately posterior to the Western main range (W. S. II,) near its S. point; apparently not in the immediate vicinity of any range of Trap on the

surface. At different points, in connexion with the Western line of Trap, within the limits of the present division, finer grained and more argillaceous varieties of indurated Sandstone occur, usually of a dark purple, passing to black, but sometimes varying to a bright red colour. The finer grained and more indurated varieties frequently form elegant jaspers; while the coarser varieties more nearly resemble porphyries. Rolled fragments of the different varieties abound in some parts of the diluvium, along the East border of the Chloritic formation (A W.,) South of West Rock. In the lower ridge, accompanied with dikes of Trap, terminating the range of Mt. Carmel on the N. E., a remarkable variety of sandstone occurs, forming irregular beds in a coarser, reddish, decomposable, rather thinly schistose variety. This sandstone is hard and apparently indurated, usually fine-grained, of a light reddish cream colour, with more or less of a light yellowish green mineral (epidote) disseminated, thus often forming a beautiful material for architecture; but unfortunately it does not form beds sufficiently regular and extensive to be worked to advantage. This rock is chiefly composed of a reddish felspar. Other varieties of indurated sandstone, in the same ridge, accompanied with a more remarkable development of the epidote, have already been noticed.

The most remarkable circumstance, connected with the present division, is the series of veins of sulphate of barytes, crossing the sandstone, from West to East, in a line nearly directly transverse to the strata, and nearly parallel to the East—West dike-like range of Trap (P. 2,) posterior to the Western main range (W. S. II,) in the S. E. part of Cheshire. The veins of barytes rarely exceed four feet in width, and are nearly vertical, but somewhat irregular in inclination and direction. They do not form one continuous range, but are interrupted, with lateral shifts, similar to the arrangement of the Trap range, to which they are parallel. They are chiefly composed of the sulphate of barytes, but are accompanied with traces of copper, geodes of quartz, and nodules of a very

fine-grained red sandstone, apparently the result of concretion, and often surrounded with a coating of crystalline quartz. This range occurs distinctly, only in a line parallel to that part of the Trap range (P. 2,) between Gaylord's mine and the valley of Neck river, although slight traces have been observed, in the same line, West of that valley, and parallel, on the North, to the dike, in the same Trap range, at J. Brooks'.

The elevations of the sandstone, in the present division, exhibit some peculiarities, caused by the peculiar arrangement of the Trap. Two long ridges, directed N. N. E., rise in front of Mill Rock and Pine Rock, respectively, in the plain bordering the Southern limb of the main curve (W. S. I) on the South, and also in a lateral position, one to the W. front of East Rock, the other to the S. E. point of West Rock. Another range extends from the N. W. point of East Rock, to the S. front of Mt. Carmel, presenting an arrangement, in the order of succession of its different ridges, and the curve resulting, very similar to that of the corresponding Trap range (W. S. I.) A similar range, already noticed, extends from the N. E. point of Mt. Carmel, towards the S. point of the Hanging Hills, approaching, on the North, the outwork fronting the latter range, and apparently assuming there a position conformable to it. A parallel range commences farther North, on the West side of the posterior range (P 1 W. S. II,) crossed in its Southern part by the East—West Trap range, and its parallel range of barytes veins, farther N. bordering the basin of Broad Swamp on the West, and towards its N. point, advancing West, as if conforming to the advance of the Eastern line of elevation, at the Hanging Hills, and at last terminating S. of the Quinipiack, bordered there on its West side by a link in the N. part of the Western main range (W. S. II.) This Northern part of the range in question, may also be regarded as the N. part of a range, represented on the map, conforming in its outline to the main Trap range, last noticed. A series of sandstone ridges also occurs in the concavity of the West Rock range (W. S. I,) most largely developed towards the North, and rece-

ding N. Easterly, conformably to the Trap range it accompanies.

The remaining division (3) of the Western Sandstone, includes all that portion of it fronting the fourth Eastern Trap system, and embraces, within its limits, the Northern section in the Western line of the Trap. The sandstone, in that part of it S. and E. of the latter Trap range, is usually less coarse-grained and decomposable, and of a more uniform red colour, resembling that immediately fronting the Eastern line of the Trap, in the S. E. division. In several instances, from its grain, thickness and durability, it is well suited for quarrying, as in a ridge West of Farmington; in another, of little elevation, traversing the plain W. of Farmington river, in Avon and Simsbury; and at some points near the base of the Talcott Mountain range, where it underlies the Trap, from which it is apparently separated throughout, by a band of friable shale. The sandstone, of the ridge West of Simsbury, is usually of a light brick red colour, resembling that of a range already referred to, along the Eastern border of the Secondary, E. of the Connecticut. In that part of the present section, included between Manituck Mountain and the West front of the Eastern main range, at Newgate Mountain, a variety of sandstone occurs, usually fine-grained, and easily wrought; distinguished by thin alternate bands or stripes of darker and lighter red, giving it often an elegant appearance. The sandstone, in the elevations N. of the main Trap range (W. N.,) is usually coarser grained, more decomposable, and somewhat variegated, resembling that of the S. W. division. This occurs in a group of elevations, in the North of Granby and in Southwick (Mass.,) arranged apparently as an outwork to that part of the main Trap range, just referred to, including the N. limb of its Southern curve (1 γ,) and the whole of its N. curve (2.)

The country, throughout the greater part of the present division, is occupied by a plain; the sandstone rarely rising to any considerable elevation. A range, however, extends, with little interruption, from a point N. W. of the abrupt flexure of

the main Trap range (W. S. II,) at the passage of the Farmington Canal, Northerly, in a line nearly parallel to the E. main Trap range, to the S. point of the N. section of the W. main Trap range. The sandstone of this range is usually of an uniform dark red colour, from which circumstance, a part of the range (N. W. of Southington) is called Red Stone Hill. This range apparently forms a connecting link between the N. and S. sections of the W. line of elevation of the Trap system, and includes, in its N. part, the dikes and dike-like ridges, already noticed, S. of the N. section of the same line. The low ridge of sandstone, W. of Simsbury, is nearly parallel both to the E. and W. main Trap ranges at that point, and is nearly in the line of the N. curve of the main Trap range (W. N.) A group of elevations, already referred to, rises N. of the same main Trap range, presenting two subordinate groups; one in Granby, N. of the N. limb of the S. curve of that range, to which it corresponds, and another N. N. W. of the N. point of Manituck Mountain (the N. termination of the same range.) Only one other considerable elevation of sandstone rises, farther N., in this division; about W. S. W. from the S. point of Mt. Tom. The Eastern main Trap range is usually merely underlaid by sandstone; its ridges often sinking abruptly to the plain on the West. The only remarkable exception is in the interval between it and the Western main range, at Newgate and Manituck Mountains, where the Eastern range is bordered by an outwork of sandstone, leaving only a narrow valley, on the E. side of the Western range, at the line of the Farmington Canal. It is in the Southern part of this outwork of sandstone, that the anterior range of amygdaloid (E. IV 2 A) is developed.

(M.) The Middle Shale range forms a band of variable width, along the E. side of the Eastern main Trap range, and also occupies the interval between the main and anterior ranges in the fourth, and Northern half of the third Eastern systems. It frequently, perhaps generally, occurs also as a narrow band, interposed between the main Trap

range, and the underlying sandstone, where the approximate anterior range is wanting. It thus appears to have a peculiar connexion with the Eastern main Trap range, although, as already stated, thin bands of shale are sometimes observed, in immediate connexion with the Trap in the Western main range. The Shale is of small extent, in connexion with the first, second, and S. half of the third Eastern systems, and forms an extensive range, only in connexion with the fourth system, and the N. half of the third, particularly the former. The Shale, posterior to the fourth system, and the adjoining part of the third, is harder and darker coloured, than that farther S., or anterior to the main ranges of those systems, and has apparently undergone a greater degree of induration. It is there usually of a dark red brown colour, partly thicker and more even, breaking by natural cleavages, usually in large rhombic fragments, and partly thinner, and breaking in small irregular shelly fragments. The shale in other parts of the present range, is usually light red, softer and more easily decomposable. The greater part of the shale, in every part of the range, is compactly fine, and uniformly argillaceous, as if formed from an indurated mud. Occasionally beds occur of a finer or coarser micaceous shale, a remarkable variety of which has been noticed as overlying two of the posterior Trap ranges of the fourth system (1 P. W. 6—E. 2.) The finer red micaceous shales are most abundant on the E. border of the range.

Beds of Sandstone, usually of a very fine-grain, are occasionally found interposed in the shale of the present range, most frequently towards its Eastern border, where it passes into a schistose sandstone, extending along the Western border of the Eastern Sandstone range. This sandstone, found in connexion with the harder shale, posterior to the fourth system, is usually lighter red than the shale, and often extremely hard and indestructible. Such a sandstone, in beds of considerable thickness, is found in the range of shale crossing Farmington river at Poquonock bridge (Windsor.) A pecu-

liar argillaceous sandstone, usually very fine-grained, and of a light red or yellow brown colour, often thick bedded, and apparently well fitted for a freestone, is found imbedded in the band of shale underlying the second Eastern main range (Toket Mountain,) and the S. part of the third, and occasionally also in the band interposed between the main range and the anterior amygdaloidal range, farther North. The most remarkable locality of this sandstone underlies the West front of Toket Mountain, in the vicinity of the peculiar variety of variegated sandstone, noticed in the valley of Farm river. It is there associated with an extremely friable, soft light red shale.

Beds of dark bituminous, and light brown, occasionally fetid shale, are not unfrequent in the present range; sometimes of large extent. The bituminous shale sometimes contains very thin interposed seams of coal, but this is comparatively unfrequent. Organic remains (of fish and vegetables) are less frequent in the bituminous shale of the present range, than in similar beds connected with the Eastern Sandstone range. Impressions of fish have been observed in such beds in the shale, near its E. border, in Westfield (Middletown,) and in Stepney (Wethersfield;) in the latter place, at the excavation for coal, connected with the Rocky Hill Trap range (E. IV 1 P. E. 2.) Impressions of vegetables have been found in a bed of shale, underlying the posterior Trap range (E. IV 1 P. W. β,) W. of the Rail Road Depot (Kensington.) The bituminous shale sometimes abounds in disseminated pyrites. A thick bed of a hard black shale, crossing Farmington river, W. of Rainbow village (Windsor,) contains between its layers large stellated flakes of pyrites, besides that more minutely disseminated. In a bed of bituminous shale, recently excavated in the valley between the Trap ranges (E. III 3) and (E. IV 1 P. E. 1,) films of pyrites were found between the layers of the shale, forming dendrites, not a little resembling some species of ferns or algæ, but obviously merely of mineral origin. These films also left very distinct impressions on the surface of the shale.

Seams of bitumen occur in the cross cleavages of the bituminous shale, occasionally accompanied, as in a large bed at Hart's Mills (New Britain,) with brown spar and fluor. In a few instances, cross seams of bitumen, also accompanied with brown spar, usually very ferruginous, are found in the common red shale, in situations quite remote from the Trap. Beds of a dark bituminous and a light blue fetid limestone, are found accompanying the beds of bituminous shale. The largest occur in the band of shale, interposed between the fourth main Trap range and its anterior amygdaloidal range, between Southington and Berlin, where the limestone is extensively used in the manufacture of water cement. Traces of the same have been observed, throughout this anterior band of shale, from the N. point of Toket Mountain to Farmington. A bed of a light blue limestone occurs in the bituminous shale at Hart's Mills, and another in the range of shale already noticed, immediately anterior to the posterior range (E. IV 1 P. W. α.) The latter may be traced, from the curve Westward in the Trap range (α,) S., nearly in the line of the Rail Road, to a point W. of the N. point of the anterior range of Lamentation Mountain, and of course some distance farther S. than the Trap range it accompanies. This limestone is very fine-grained, hard and compact, and has been excavated for constructions on the Rail Road. It resembles, as well as that at Hart's Mills, some of the limestones, used for cement, in the range E. of Southington, and might undoubtedly be used for a similar purpose. The beds of bituminous shale, above noticed, are sometimes accompanied with dikes of indurated clay, already referred to, and are then apparently in the line of a range of Trap, beyond the point of its termination.

The shale, connected with the first Eastern system, forms only a thin band, adjoining the main Trap range, both anteriorly and posteriorly, at least in a part of its extent. That connected with the second system (Toket Mountain,) forms a wider and more continuous band, underlying the main range, throughout the greater part, if not the whole of its extent, in-

cluding, in its N. part, near the Northford limestone (connected with the anterior amygdaloidal range,) a small bed of bituminous shale with limestone, and at its N. E. point (North of Bluff Head,) a bed of soft red and blue clay, formed from decomposed shale, containing cross seams of a peculiar indurated bitumen. The beds of fine-grained sandstone included in this anterior band of shale, have already been noticed. A similar band of shale overlies the second main range, on the East, at the N. E. point of which a bituminous shale occurs, in which impressions of fish have been observed. The anterior band of shale underlies the third main range, S. of its central pass, and occupies the interval between it and the anterior amygdaloidal range, N. from that pass to the N. W. point of Lamentation Mountain, where it unites with the main body of the shale, posterior to the fourth main range. East of the third main range, to the N. point of Middletown Mountain, and of the Trap range (P. 3,) continued from that point, to the N. limb of the third main range, the shale is generally more arenaceous and micaceous, than that posterior to the fourth main range, and is intermediate, indeed, in its character, between the shale of that division and the Eastern Sandstone.

The extent of the anterior band of Shale, accompanying the fourth system, has already been indicated. The range of Shale posterior to the fourth system occupies the whole extent of country between the fourth main range and the Connecticut, and may be also considered as including the shale, accompanying the N. W. part of the third system. This is the proper range of the Shale, in the Southern basin of the larger Secondary formation, in which that rock also possesses a character not a little distinct from that of the shale in other parts of the formation, as already indicated. This range also occupies the country, to a certain width, East of the Connecticut, at least from the vicinity of Warehouse Point (East Windsor,) Northward. The elevations of the shale, in this extensive section, correspond to those of the Trap, in a manner no less striking than those of the Western Sandstone. A range of

rounded hills, covered on their summits with diluvium, but apparently based on ridges of shale, (or in the more Southern part, of sandstone,) extends along the East side of the main range of the third and fourth systems, presenting a general conformity, in its elevations, with those of the main Trap range. These summits sometimes nearly equal in height the corresponding points of the Trap range, and form conspicuous objects in the landscape. Those accompanying the third main range are most elevated, posterior to the Northern part of that range, so far as it is included in the main Eastern line of elevation; while those accompanying the fourth main range are highest, posterior to the Southern section of that range. The ridges of shale, accompanying the Eastern section of the posterior ranges of the fourth system, conform in their direction to that of the Trap ranges; thus bearing N.N.W. at the passage of the Middle Turnpike between the Western and Eastern of those ranges, conformably to the direction of the latter range at that point. The elevations of the shale accompanying the posterior ranges of the fourth system extend farther N. than those ranges, but subside on the South side of Windsor plain, forming only low swells, as they traverse the latter, with a few exceptions. A group of ridges rises farther North, in Suffield, and immediately adjoining the Connecticut on the East, in Enfield; apparently corresponding to the abrupt elevation of the fourth main Trap range, at the S. termination of the second division of its Northern section (at Newgate Mountain.)

(E.) The Eastern Sandstone range includes all that portion of the larger Secondary formation, East of the Middle Shale range. The Sandstone of this range is usually of a more uniform red or reddish grey, and rarely variegated, like that of the S. W. part of the Western range. It is generally also less decomposable than the latter, and resembles more, in its character and durability, the sandstone on the Eastern border of the Western range. The sandstone, on the Western border of the present range, at least that posterior to the third Eastern sys-

tem, is more argillaceous and schistose, and usually more or less micaceous, approaching, in its character, the shale posterior to that system. Farther East, the sandstone of the present range is usually thick bedded, occasionally alternating with beds of a thinner schistose variety; varying from very coarse to fine-grained, and from a light reddish grey to a dark red colour. It, however, presents several peculiar varieties, in different parts of the range. Occasionally, where the sandstone is generally fine-grained, beds of a coarse conglomerate are included, usually composed of more rounded fragments, than that adjoining the Eastern Primary. Beds of red friable shale, and also of bituminous shale, occasionally occur in the sandstone of the present range; the latter more particularly in that posterior to the third Eastern system. These beds of bituminous shale are accompanied with layers of bituminous limestone, brown micaceous slaty sandstone, and a thicker dark indurated clay, breaking in glazed conchoidal fragments. These beds are the principal depositaries of the fish impressions, found in the Southern basin of the larger Secondary formation, comparatively few having been found in the Middle Shale. These impressions of fish are also accompanied with vegetable remains, resembling *calamitæ*. The most important of these localities is situated near the line of Middletown and Durham, West of the New Haven Turnpike, but a series of similar beds of shale may be traced from that point, N. N. E. nearly in the line of that Turnpike, towards Middletown city. A bed of bituminous shale, containing fish impressions, is also found in the S. W. part of Durham, in the bed of the S. W. branch of the Aramamit, in the interval between the N. E. point of the range of Paug Mountain (E. III 1) and the S. W. point of the posterior range (E. III P. 2 S.,) to the last of which it is properly anterior. A similar bed of bituminous shale occurs at a short distance W. of the latter Trap range, at the passage of the brook S. W. of Middlefield meeting house; perhaps connected in its range with the former locality. The bed of shale, containing fish impressions, in

Westfield, is in a similar relative position to the Northern section of the same posterior range (E. III P. 2 N.)

Along the immediate Eastern border of the Secondary, a band, usually of no great width, extends throughout the greater part of the present range, composed of a very coarse conglomerate, consisting chiefly of slightly altered angular fragments of Primary rocks, usually distinctly traceable to the adjoining Primary formations. These fragments are usually but slightly cemented by a dark red argillaceous cement, and in some instances, readily disintegrate, forming a debris resembling that of Primary ledges. In one instance, E. S. E. of Middletown city, a bed of a dark bituminous micaceous shale occurs in connexion with this band of conglomerate. A remarkable ridge of conglomerate has already been noticed, in connexion with the N. E. point of the third Eastern main Trap range. This ridge extends nearly East and West, in a direction conformable to that of the same range, but in a line farther S., and with a dip to the South, as if elevated by the force of the Trap, on the North. This ridge consists of Primary fragments, many of which can be traced to the adjoining Primary, particularly to the dark micaceous gneiss of (C 1,) extending along its Western frontier; but numerous fragments occur of a greenish grey Talcose Slate, not unlike a variety occurring in the Chloritic formation (A W.,) or even more like the Talco-Chloritic Slate of (O W.,) on the opposite border of the Western Primary.

The Eastern Sandstone, posterior to the first Eastern main Trap range, forms two groups of rounded elevations, included in the curves at the N. and S. extremities of that range, and separated by a basin, opening S. E. by the South point of the Eastern posterior Trap range (P. 2.) The sandstone of this division is usually rather coarse-grained, and of a light red, or reddish grey, with occasional beds of a friable red or brown shale. The range of coarse conglomerate, along its Eastern border, is most extensive towards the N. East, particularly opposite the N. East point of the Western posterior Trap

range (P. 1,) as already noticed.—The Sandstone, posterior to the second main Trap range, forms a series of high rounded, diluvial covered hills, ranging N. Easterly, in a direction conformable to the course of the main Trap range, while along its Eastern border extends a series of lower ridges, more immediately connected with the posterior Trap ranges. The series of higher ridges, on the West, presents two groups of elevations, (one towards the S. W., the other towards the N. E.,) corresponding to the two subordinate curves of the main Trap range, and separated by a wide valley, extending South from the N. E. point of the Southern of those curves, by the W. front of the S. W. point of the Southern posterior Trap range (P. 1.) The N. Eastern of those groups is the most elevated, the highest summit of which, called the Sugar Loaf, is even more elevated than the corresponding main Trap range. The sandstone of this division is very similar to that of the preceding, usually rather coarse-grained, but occasionally sufficiently fine-grained and durable, to form a valuable freestone. The sandstone, fronting the posterior ranges, particularly the Southern, is usually coarser grained, lighter grey and more granitic. A narrow range of coarse conglomerate generally extends along the Eastern border of this division, already noticed more particularly in connexion with the Northern posterior Trap range (P. 2.)

The Sandstone, posterior to the third main Trap range, may be divided into two sub-divisions, separated by the valley of the Aramamit, and the Connecticut. The Western of these consists of the schistose variety, approaching in its character the shale, which it adjoins on the West, and conforms, in its elevations, to the larger posterior range of the third system (P. 2.) The Eastern sub-division generally resembles, in the character of its sandstone, the two preceding divisions, but is apparently distinguished by its beds of shale, with fish impressions, already noticed. N. E. of Durham commences a range of hills, apparently forming a strongly marked curve, including, on the North, the ridge W. of Middletown city,

and that at Portland (Chatham.) In the latter, on its Western declivity, are situated the celebrated freestone quarries, among the most extensive in the United States. The S. E. point of this range is E. S. E. from the N. termination of the posterior Trap range (P. 2 S.,) W. of Durham, and is intermediate, in position, between the S. point of the fourth Eastern main Trap range, and the corresponding bend in the larger Eastern Trap Dike, in Middle Haddam. The coarse conglomerate is generally observed, along the Eastern border of the present division, but is most conspicuous at its N. and S. extremities. The ridge, at its N. extremity, has already been noticed. At its Southern extremity, it generally occupies the intervals between the Trap ridges, in the group (P. 1,) posterior to the main range of Paug Mountain, and farther N. E. a singular group of ridges of a very coarse conglomerate rises E. of the Guilford Turnpike, South of Durham village, in a position N. E. of the S. E. point of the larger posterior range (P. 2 S.,) and opposite a point where the Eastern Primary recedes rather abruptly to the N. East.

The Sandstone, posterior to the fourth Eastern main Trap range, is confined to that portion of the Secondary, East of the Connecticut, the greater part of which it includes. Along its Eastern border, a range of conglomerate can generally be traced, rarely, however, composed of such large and unaltered fragments, as that in the divisions farther South. The sandstone occupying the main body of this division, is generally rather fine-grained, hard, and of a peculiar light brick red colour. It is in this variety of sandstone, that the fossil bones, found at Catch Mills (East Windsor,) were contained. Traces of similar bones have been observed in the quarries at Wapping, farther South, but in the same range. A range of elevations, rarely of much height, has already been noticed as extending through a great part of the present division. These may be traced from a ridge of coarse conglomerate, nearly adjoining the Primary, N. E. of Glastenbury, to the Ludlow Factories, on the Chickapee (Mass.) Sandstone prevails

throughout the whole range, except at its S. termination; generally the light red variety, already noticed. The ridges, at the E. termination of the fourth main Trap range, already referred to, are chiefly composed of a coarse conglomerate, particularly as they approach the Eastern Primary.

The Northern Basin, in the larger Secondary formation, closely resembles the Southern basin in the arrangement of its Secondary rocks; presenting a Western range of Sandstone, a Middle range of Shale, and an Eastern range of Sandstone. The former of these fronts the Trap range of that basin, forming a nearly continuous series of ridges, most elevated towards the South and North; particularly in the former direction, where it terminates in the high detached summit, called the Sugar Loaf. The middle shale forms there, as in the first and second systems of the Eastern Trap range, in the Southern basin, only a narrow band, overlying the Trap range, on the East. The Eastern sandstone forms a more extensive range, including the high summit of Mt. Toby, on the South, and a series of lower ridges, extending to the N. bank of the Connecticut, in Gill. Along its E. border extends a coarse conglomerate, very similar to that on the E. border of the Southern basin. The impressions of fish and vegetables, observed in the N. basin, are found in the middle shale, and in beds of shale, accompanying the Eastern sandstone, as in the Southern basin.

The Sandstone of the Smaller Secondary Formation is chiefly confined to a narrow underlying range, anterior to the Trap range of that formation, apparently most developed at the S. W. and N. E. points of that range. At one point, in the former direction, S. of the Pomperaug (South Britain,) a mass of sandstone reposes on the Primary (Mica Slate, G S. 3 «,) dipping N. E. from the latter, and towards the S. front of the Trap range, at a large angle; but generally the sandstone appears as an outwork to the Trap, separated from the Primary by a valley of greater or less width. The sandstone of this anterior range is either coarser grained, lighter red, and more

granitic, or finer grained, darker red, and more argillaceous; the latter sometimes forming a valuable freestone. Both varieties, particularly the latter, are characterized by pores, usually small, lined with a black or purple ferruginous coating, forming quite a distinctive peculiarity. The Shale of this formation occupies the space included between the main Trap range and its anterior amygdaloidal range, and apparently between the main range and its posterior range, although the latter interval is chiefly covered with diluvium. The shale is, however, scarcely developed, except in connexion with the Southern section of the Trap range, at its S. Western extremity. The peculiar arrangement of the shale has already been noticed, in connexion with the Trap range. The shale of this formation is usually very soft, argillaceous, and friable, chiefly light red, with beds of brown and dark bituminous shale, including thin beds of dark and light grey bituminous limestone. Impressions of fish are found in these beds, particularly in the limestone. Seams of indurated bitumen, and also of mineral caoutchouc, occur in the bituminous shale and limestone, and the latter, particularly, is sometimes impregnated with naphtha. Excavations have been made for coal in the bituminous beds connected both with the main and posterior Trap ranges, but without success. Beds of a soft, thin, light brown shale occur, particularly in the excavations between the main and anterior ranges, breaking into very small jointed fragments, frequently separated by cross seams of fibrous calcareous spar, forming elegant septaria. No appearance of an Eastern range of sandstone has been observed by me in this formation. If it exists, it is apparently covered by diluvium.

From the preceding statements, the similarity of the arrangement of the Secondary rocks, in the different basins, is sufficiently obvious, as well as its conformity, in a certain manner, with the arrangement of the Trap. The arrangement, at the Southern extremity of the Western basin, resembles most nearly that at the Southern extremity of the fourth Eastern system, in the S. basin of the larger Secondary form-

ation, which latter point may be regarded as the focus of the Trap in that basin, the greatest elevations, with one exception, and the greatest number of distinct ranges of Trap, there occurring.

An impression has long prevailed that Coal may be found in the two Secondary formations of the State. The Sandstones and Shales of these formations, in their physical character, are not unlike those of undoubted coal formations, and the beds of bituminous shale, often with limestone, accompanying the shales, in both formations, and also the Eastern range of sandstone, in the larger Secondary formation, offer, at first sight, not a little encouragement to that expectation. No beds of coal have, however, been discovered by the numerous searches which have been made in these localities; only seams of bitumen, and very thin layers of coal, apparently formed from the remains of vegetables, having been detected. In no instance, I believe, have any impressions of the vegetables usually accompanying coal beds (ferns,) been found in the Secondary rocks of the State. The animal and vegetable remains, found in these rocks, rather resemble those accompanying the new red sandstone, than those peculiar to the proper coal formations. Perhaps, however, beds of coal may be found at a greater depth, than any explorations have yet reached. The greatest quantities of combustible matter, considered as coal, hitherto observed in these formations, have been found in connexion with the Trap, in localities already referred to, in Berlin and Farmington, in different ranges belonging to the fourth Eastern system of the larger Secondary formation. This substance, however, is a more or less indurated bitumen, similar to that occasionally occupying the pores of amygdaloid, or accompanying metallic veins in the Trap and the adjoining indurated sandstone, and is perhaps derived from the same volcanic source, as the Trap it accompanies.

II. Diluvium and Alluvium.

Under these heads, are included all the unconsolidated materials, accumulated on the surface. These are either accumulated loosely and irregularly, or arranged in distinct beds or strata. The former were apparently deposited by currents, sweeping over the general surface, or more confined in their operation, or have been derived from the decomposition of the rocks, on which they immediately rest. Neither of the terms, given above, are properly applicable to the latter, but as it is not always easy to distinguish these from such as have been undoubtedly transported, they may not improperly be considered in connexion with them. The stratified materials were apparently deposited from water, in a state of comparative repose, as in lakes and æstuaries, and are generally found in valleys or basins, at lower levels than the preceding. These are partly above the reach of the waters of the present period, and partly at their level, and still in a process of formation. The term *Diluvium*, may be applied to the unstratified materials, above noticed, and the term *Alluvium*, to those arranged in strata.

The greater part of the Diluvium was apparently deposited by a general current, traversing the surface from N. N. W. to S. S. E. This is satisfactorily indicated both by the bowlders, scattered over the surface, or imbedded in the diluvial earth, and by the smaller fragments included in the latter, as well as by its general character. Thus in the diluvium, on the Western border of the State, particularly towards the North, bowlders and fragments are frequent, from formations beyond the limits of the State, including the argillite and blue limestone, W. of the Dover valley, and others still farther West, and even the soil, where of diluvial origin, resembles that of Dutchess County (N. Y.) Such diluvium may be distinctly traced, as far S. as Wilton, where fragments of the Mica Slate (M,) West of the Dover valley, and of the Argillite (O) and its accompanying Talco-Chloritic Slate, are sometimes found

abundantly in the diluvial soil. The diluvium, derived from the Secondary formations, particularly from the larger Eastern formation, is in like manner conveyed, to considerable distances, in the same S. S. E. direction, into the adjacent Primary. Fragments of the sandstone of the larger Secondary formation, have been conveyed even as far as Montville, and along the valley of the Shetucket to Franklin. In order to determine the direction of the diluvial currents, a particular knowledge of the local character of the rocks, as indicated in the account already given of the different local formations, is indispensable. Several of those local formations are so peculiar in the character of their rocks, that the latter cannot be mistaken, to whatever distance they may have been transported. These, by the distribution of their bowlders and fragments, furnish conclusive evidence that the more general direction of the diluvial current was S. S. E. Thus the peculiar limestone of South Canaan, accompanied with fetid quartz, white pyroxene and tremolite, as well as the white pyroxene rock associated with it, is found, in frequent bowlders, scattered over the surface in that direction, through Goshen, as far as Litchfield. These were found in such numbers, in Goshen and the N. part of Litchfield, at their first settlement, that several kilns were erected for burning them into lime. These bowlders are sometimes of great magnitude. One, at least fifteen feet square, was observed on the line of Goshen and Litchfield, and another much larger on the summit of a high ridge, in the N. of Goshen, several hundred feet above the present level of the limestone in Canaan. The rocks of the Porphyritic formation (G S. 3 ζ,) West of Litchfield, furnish also a striking instance of a similar diluvial transportation to the S. S. E. Blocks of the peculiar rocks of that formation, particularly its large porphyritic and sienitic rocks, are scattered over the surface in great numbers, through South Farms (Litchfield,) and the E. part of Bethlehem, as far as the country between Watertown and Woodbury. In South Farms, where the prevailing rock is a thin decomposable mica slate

(G S. 3 s,) they form the common materials in the stone fences. The red granite, accompanying the micaceous gneiss of the Calciferous formation (H 1,) is frequently found to a considerable distance S. Easterly, within the limits of the range (F,) where the granite and granitic gneiss have a very different character. The bowlders of the different Porphyritic ranges, accompanying (H—F—D,) may also be traced in the same direction, to a greater or less distance from their known locality in place. Thus the large porphyritic rock, extending along the E. border of (D,) is often found in large blocks in Milford and North Orange, and occasionally in smaller blocks, within the limits of the Secondary, near New Haven. Blocks from the Western Primary are occasionally found scattered over the central and Southern parts of the larger Secondary formation, in a line from West Hartford, through Berlin and Meriden, to Mt. Carmel. These are chiefly derived from the Northern part of the Mica Slate formation (G,) and perhaps from that part of it within the limits of Massachusetts, N. N. W. from the points where they now are met with. They consist chiefly of the coarse white granite, accompanying the mica slate, the granitic gneiss of the included basins, and a light bluish compact mica slate, with transverse scales of mica, found in the middle range of (G N.,) and said by Professor Shepard, to abound in the vicinity of Conway (Mass.)

In the Eastern Primary, the S. S. Eastern direction of the main diluvial current is most strikingly indicated by the blocks of the two Sienitic (Porphyritic-Hornblendic) formations of Lebanon and Preston (E 3—F 3.) The blocks of those formations are found in great numbers, for a certain distance in a S. S. E. direction; those from the Lebanon formation having been apparently obstructed in their progress by the high ridge of the Mica Slate range (E 6,) in Franklin, but few being found farther S. E.; those from the Preston formation, presenting a stream of blocks, diminishing in size and frequency, in their progress, extending through the S. W. part of North Stonington and the central part of Stonington, as far

at least as Stonington Point. The Trap of the dikes traversing the Primary, both Eastern and Western, also furnishes evident proof of the same direction in the diluvial current; blocks from those dikes being found almost invariably on the Eastern side of the dikes to which they belong. In some instances, these blocks are more thickly accumulated, presenting a stream in a S. Easterly direction, but in these instances their diffusion and detached position indicate satisfactorily their diluvial character. No instances have occurred to me, where any extensive range of dike lay in a S. Easterly direction; the general direction of all those traversing the State being N. N. Easterly.

In several instances, the diluvial current was apparently obstructed, in its progress S. Easterly, by the higher ridges crossing the line of its direction. Thus a Secondary diluvium from the larger Secondary formation, chiefly composed of small rolled fragments of the light red sandstone of the Wapping range, is often accumulated in large quantities on the Eastern Primary, West of the Bolton Mica Slate range (C 3,) while it rarely occurs East of that range, and then, for the most part, only opposite the lower passes in the range, particularly that at Dark Hollow (Marlborough,) and that at the passage of the W. branch of the Willimantic, in West Stafford. The same obstruction has been presented by the higher ridges, along the Western frontier of the Granitic formation (A,) East of the Connecticut; blocks and fragments of the more Western formations being rarely found within the limits of that formation, except in the vicinity of valleys, traversing its frontier range. The blocks of the Norwich range (F 2,) from their very peculiar character, are very easily recognized. These are rarely observed, East of the high ridges, extending along the Western border of (A,) East of the Quinabaug valley, and even scattered fragments are scarcely met with, at the distance of two or three miles from the frontier of that formation. The more extensive diffusion of the diluvium, on the Western border of the State, has been already alluded to.

The force of the diluvial current was apparently greater in that direction, having been less obstructed in sweeping over the comparatively level Secondary formations, farther N. W., and approaching through the interval between the Catskill Mountains, on the South, and the Primary Mountains, at the source of the Hudson, on the North; while in traversing the more elevated Primary country of the State, whose ridges are generally in a direction crossing that of the current, the force of the latter became sensibly diminished in its progress S. E.

Although the general direction of the diluvial current was apparently S. S. E., yet in some instances, from local obstructions, its course was deflected to a S. S. W. direction. This is most distinctly obvious along the Western border of the larger Secondary formation, where blocks and fragments of the Trap and Sandstone of that formation are accumulated, sometimes quite abundantly, in such a direction from their apparent source. This is more particularly the case, towards the Southern part of that formatien, and is scarcely observed N. of the point where Farmington river issues from the Western Primary. The current has apparently been deflected, in this S. S. W. direction, by the West fronts of the higher Trap ridges, particularly those in the Southern part of the fourth Eastern main range, and those of the Southern section of the Western range, particularly that of West Rock. The most remarkable instances of bowlders, conveyed apparently by a S. S. W. current, are presented by a series of large bowlders of Trap, resembling that of the ranges traversing the Secondary, particularly that of the fourth Eastern main range, crossing the plain in Southington, in that direction, to a point on the summit of the ridge in the Western Primary, immediately adjoining the Secondary, about West of the S. W. point of the range last mentioned. Numerous blocks of such Trap are scattered over the Primary, at that point, one of which, of very large dimensions (at least 30 by 15 feet,) occurs on the summit of the Primary ridge, above referred to, several hundred feet above the plain, between it and the fourth Eastern main range.

This bowlder is at a short distance from the Trap dike, already noticed, in the S. E. corner of Wolcott, but differs from the Trap of the latter essentially, in its physical character. Still larger bowlders occur in the plain, in Southington and the S. part of Farmington, in a N. N. E. direction from the former. Blocks of sandstone were observed in the valley extending along the East side of the Mica Slate range (E W.,) nearly as far S. W. as the Straits, and at a distance of 5—6 miles from the Secondary, in the direction of the valley. Blocks of Trap and Sandstone are accumulated on the Eastern border of the Argillite (B W.,) near the N. point of the Chloritic formation (A W.,) and opposite the W. front of the West Rock range, and are scattered, more or less frequently, over the Chloritic formation, in a S. S. W. direction from West Rock, as far as the Sound, near Oyster river. Blocks of the limestone of the latter formation, resembling that of the New Haven Quarry, characterized by its light yellow serpentine, are also found accompanying the Secondary bowlders and fragments, in the same S. S. W. direction from their probable source. This deflected current has apparently conveyed the Primary bowlders in other instances in the same direction. The peculiar white mosaic granite, found near the line of junction of the Mica Slate (C W.) and the Argillite (B W.,) occurs in large scattered blocks, in a direction S. Westerly from the rock in place, on the E. border of the Mica Slate (C,) at points where no appearance of beds or veins of the rock is observable.

A large portion of the Diluvium of the State, composed of smaller rolled fragments (gravel and cobble stones,) has been apparently deposited by currents of more confined and local operation. This variety of diluvium is usually found at comparatively low levels, in valleys or basins, and is itself generally so distributed as to indicate a similar S. Easterly motion in the currents which conveyed and deposited it. It frequently occurs unusually accumulated at the S. or S. E. extremities of extensive valleys or basins, both in the Secondary and the Primary, where they are closed by ridges, so as to prevent the

farther progress of the current, and is there often heaped in rounded hillocks, with similar intervening hollows, as if subjected to the action of eddies. A diluvium of this kind is accumulated in the S. E. corner of the Berkshire valley, in North Canaan, abounding in the quartz rock of that valley, and frequently including fragments of hematite and ferruginous (hematitic) breccia, and is conveyed through a depression in the N. front of Canaan Mountain, into the valley, West of Norfolk village, extending S. S. E. towards the sources of the Naugatuck. Small rolled fragments of hematite, and of a ferruginous quartz, accompanying it in its beds, are frequently observed, scattered over the surface in the N. W. part of Litchfield County, as far East as Torringford, and are sometimes found accumulated in considerable quantities, particularly in the vicinity of the Housatonic, East of the Kent Limestone valley, and in situations, where there is no appearance of the hematite in place. These last may have been derived from the hematitic range, at the Kent ore bed, on the E. side of the same valley, not far North, or perhaps from some other locality of that ore, not yet explored, in the same part of the formation (H W.,) or they may have been conveyed from the hematitic range in the formation (M,) West of the Dover Limestone valley, through the cross valley of Dover river. These transported fragments of hematite are worthy of notice, as many persons have erroneously considered them indications of the presence of that ore in the places where they are found. The true indications of that ore have already been pointed out, in connexion with the formations (H—M W.) Similar accumulations of diluvium are observed in the cove of the Eastern Limestone valley (H † W.,) East of Shelt Rock (Danbury ;) in Newington and Berlin, included in a similar cove, surrounded, on the West, South and East, by the fourth Eastern main Trap range, its Eastern posterior range (P. E. 1,) and the N. W. front of the third Eastern main range ; in the S. part of an extensive plain or basin, in Griswold, forming a cove extending S. S. E. from the Quinabaug valley ; and in a smaller basin

on the Pachaug, in Voluntown, connected with the preceding, by the valley of that river, on the West. The Secondary Diluvium, already noticed as accumulated on the Eastern Primary, West of the Bolton Mica Slate range (C. 3 E.,) apparently belongs to the class in question. Diluvium of this kind is frequently found conveyed through valleys, opening S. Easterly, and occasionally is observed diffused around the Southern opening of those valleys, like the wash of streams, around their issue from a narrow gorge. The following instances of this kind may be here noticed. A valley opens S. S. E. from the larger Secondary formation, between the N. point of (B3 E.) and the W. front of (C E.,) nearly in the direction of the reach of the Connecticut, from Middle Haddam Landing to Higganum, and also of the valley of the E. branch of Higganum river. At the N. point of the central plateau of (B 1 E.) towards the head of the latter valley, is a large accumulation of diluvium, abounding in rolled fragments, occasionally Secondary, and a similar diluvial drift is observed in the same S. S. E. direction, West of Chester Pond. The Secondary diluvium, accumulated on the Primary (C 1—2 E.,) West of the Bolton Mica Slate range, is conveyed, in any quantity, East of that range, only at the deep pass of Dark Hollow, between Glastenbury and Marlborough, around the Eastern opening of which it is diffused, in the manner above noticed. From that point Secondary fragments may be traced S. E. through Colchester and Salem, to Montville. Large numbers of them were observed on the ridge West of Gardner's Pond, most of which could be distinctly traced to the Wapping Sandstone range. Fragments, transported in this manner by currents, in the more general S. Easterly direction, are apparently at times conveyed in a different direction, through the valleys of rivers, traversing their route, either by the floods of the rivers, or by currents of a much greater elevation. Thus fragments of sandstone, apparently carried into the basin of the Willimantic in Stafford, by diluvial currents, such as have been previously described, either from the S. W. through the valley by Square

Pond, by a reflected current from the Secondary in Vernon, or from the valley of the Chickapee, by the valley extending S. through Monson, along the E. side of the Mica Slate range (C 3 E.,) have been conveyed, obviously by the floods of the river, as far S. E. as Franklin. A fine gravel, abounding in Secondary fragments, was observed in rounded hillocks, elevated far above the reach of the highest floods, in the valley of Salmon river, at the crossing of the Colchester and Middletown Turnpike. The different branches of this stream cross the route of the Secondary drift S. E. of Dark Hollow, and one of them (Dickenson's Brook) rises partly in that valley. A diluvium, composed of small rolled fragments, among which those of the Preston Sienitic formation (F 3 E.) are abundant, may be traced through a valley, extending S. Easterly across the Granitic formation (A E.,) from a point, East of Lantern Hill, opposite the formation (F 1,) to the valley of the Paucatuck. Sometimes these streams of rolled diluvium are observed at elevations far above the level of the present large rivers, whose beds they strikingly resemble. A stream of this kind occurs in Cornwall, in an elevated valley, opening N. W. from the hollow at South Cornwall village. These streams, thus extending through valleys, may have been deposited by local submarine currents, at a time when the surface of the State was generally beneath the waters of the ocean.

The summits of many of the highest hills, in the State, are apparently composed of accumulations of diluvium, generally with few large bowlders. These, although usually smooth and rounded, yet form elongated ridges, in the direction of the rock ridges, in the vicinity, and are thus probably accumulated around such ridges, as a nucleus, apparently by the operation of eddies. Sometimes smaller diluvial ridges are appended to them, as if by an eddy, subsequent to their own formation. Long ridges, usually of a finer diluvium, are sometimes observed, occasionally distinctly curved in their outline. These, in some instances, are so situated, in coves of valleys, as to have been apparently formed by an eddy caused by the surrounding heights.

Under the term *Alluvium*, I have included all those loose deposits, which present an appearance of stratification, or arrangement in parallel beds. These are found either at an elevation, entirely above the reach of the waters of the present period, or at a level, subject to occasional inundation. The Alluvium of the former kind, occurs in basins or extensive valleys, where it was apparently deposited by the comparatively still waters of a lake or æstuary, and occasionally also in the narrow valleys of rivers, above the reach of the highest floods. It consists most frequently of alternate beds of sand and gravel; the former usually presenting a much more distinct and minute stratification; the latter, generally without any subordinate stratification in its beds. Occasionally the stratification is undulating, as if affected by waves, at the time of deposition; the superior beds often too unconformable with the lower, as if deposited at different periods, from water in a different state of agitation. The alluvium of this class, sometimes forms rounded swells or hillocks, as if affected by eddies, in which case, the stratification usually corresponds to the form of the surface. Striking instances of this curvilinear arrangement of the strata, occur in the sandy and gravelly deposits, in the valley of the Housatonic, above Derby, and are also observable in some of the excavations, in the valley of the Quinipiack, on the Hartford and New Haven Rail Road. In some parts of the basin of the Connecticut, East of the main Trap range (E. IV,) the alluvium of the present class consists of alternate beds of sand and clay, or entirely of the latter. Instances of the former arrangement occur adjoining the Connecticut, below Enfield Falls, and on the banks of the Scantic in East Windsor, and of the latter, particularly in the vicinity of Hartford, and in the basin, occupying the centre of Berlin. In the clay beds, in both these towns, concretions of argillaceous limestone are occasionally found in great quantities, arranged conformably to the stratification of the beds, and presenting the usual imitative forms of figure stones. They occur in great abundance, on the E. side of the N. branch of

Little river (Hartford,) on the Albany Turnpike, where they are of a dark bluish grey colour, and in fracture resemble some of the compact Secondary limestones, and also in the excavation of the Hartford and New Haven Rail Road, just S. of the depot (Kensington,) where they are of a light red colour, resembling fine indurated clay, but effervesce freely. No organic remains have been observed, to my knowledge, in these more ancient alluvial deposits. The most extensive of these occupy the lower levels of the larger Secondary basin, both E. and W. of the main Trap range (E. IV,) and in the plains and valleys extending N. from New Haven Harbour. In the basins, E. and W. of the main Trap range (E. IV,) different terraces occur, above the level of the present river meadows. Two such terraces may be generally distinguished, and in some instances three; the latter perhaps caused by a deposit of such alluvium on an original elevation of the surface. The two terraces may be clearly distinguished on both sides of the Connecticut, in Windsor and East Windsor, and at the S. extremity of the basin W. of the main range (E. IV,) in the S. part of Southington, adjoining the Quinipiack. The lower terrace usually abounds more in beds of clay than the higher, and its sandy beds are also more or less argillaceous. Similar basins occur also within the limits both of the Eastern and Western Primary, as in the S. part of the Berkshire limestone valley, on Mt. Hope river, in Mansfield, and in different parts of the Quinabaug valley. The basin in Griswold, already noticed, may be regarded as of a similar character, and presents, at its Southern termination, two distinct terraces, conforming to its outline.

The more recent alluvium, subject to the action of the waters of the present period, occurs more or less in the valleys of all streams, and in swamps and marshes. It is unnecessary to enter into particular details on this subject, especially as it has no immediate connexion with the peculiar geological system of the State, which it has been the great object of my survey to determine. The river alluvions vary according to

the rapidity or slowness of the current of the different streams, and according to the character of the country through which they pass. Where the current is rapid, and the country rocky or stony, these alluvions are gravelly or cobbly, and of little agricultural value. Where the current is slow, and the country of a different character from the preceding, these alluvions consist of a clayey or sandy loam, of greater or less fertility. The meadows of the Connecticut and Farmington rivers, are well known instances of this character. Swamps, abounding more or less in peat, are found in every town in the State. Some of the larger swamps, where the soil is less peaty, might apparently be reclaimed to advantage. The most remarkable instance of this kind, occurs in the town of New Fairfield, at the point of union of the different branches of Rocky river. This stream, as it issues from it, descends rapidly to the Housatonic, and is apparently unobstructed by ledges, thus offering great facilities for drainage. A similar swamp extends along Hollenback's river, in Canaan, near its junction with the Housatonic. The peat of several of the swamps in the State, is undoubtedly valuable for fuel, and may be obtained to such an extent as, perhaps, at some future period, to render it a resource of no little importance. In some instances, the lower layers of the peat are converted into a shining black, compact bituminous substance, burning readily with a brilliant flame, and leaving a very slight residuum. A striking example of this kind was observed in a swamp, N. E. of Worthington village, on the West side of the Trap range (E. III [1].) No very extensive marshes occur on the sea coast of the State, or on the rivers near their mouths, with the exception of those on the Quinipiack. Throughout the greater part of its extent, the coast of the State is rocky, or bordered by diluvial deposits. No downs or sand banks of any extent, occur along the coast. In a few instances, banks of shells are observed along the coast; usually accumulated by the action of the waves, but in some instances apparently deposited by the aborigines. The only instance of a well characterized bed of

marl, that has occurred to me in the State, is found in the bottom of a peat swamp, E. of Farmington village, in the interval between the main Trap range (E. IV 1 9) and its anterior amygdaloidal range. This consists chiefly of a collection of very small fresh water shells, obviously derived from the inhabitants of the swamp, while in the state of a pond. It is covered by a bed of peat, several feet in thickness. A vertebra of a mammoth was found, several years since, in excavating a peat swamp, at New Britain village; the only instance of the kind, that has as yet occurred in the State. The more recent alluviums contain more or less of organic remains, particularly of vegetables, deposited, as they are now constantly, by floods, or in swamps.

The surfaces of rocks are not unfrequently marked by grooves or scratches, generally considered as produced by the action of bowlders moved along them by diluvial currents. These are usually directed either S. S. E. or S. S. W., according to the general direction of those currents, as already explained. The most striking instances of these grooves, which I have observed, are on the sandstone, in the North of Meriden, in the interval between the third and fourth main Trap ranges (Lamentation Mountain and the Hanging Hills.) They there occur in both the directions above specified, but more frequently in a S. S. W. direction, conformably to the direction of the reflected current, apparently produced by the resistance of the adjacent Trap ranges. Water-worn appearances are sometimes observed on the rocks of the State, particularly the sandstones, at an elevation far above the reach of the waters of the present period. A striking instance of this kind occurs in the sandstone, at the South end of the posterior range (P. 1 W. S. II,) in North Hamden, apparently formed by the long continued action of a current. Another, at a less elevation, is found on the sandstone, bordering the Trap, on the East, at the S. E. point of the East Rock range. Similar appearances, accompanied with pot-holes, are found in the rocks, on the banks of the present rivers; sometimes, however, dis-

tinctly elevated above the reach of the highest floods. Appearances of a similar kind sometimes occur, where the effect has been undoubtedly produced by the decomposing influence of the atmosphere. Thus the surface of the dark sub-porphyritic gneiss (F 4 a W.,) E. of Ridgefield, is sometimes marked by smooth rounded cavities, arising from the disintegration of decomposable nodules in the rock, and a variety of dark micaceous, sub-hornblendic gneiss, along the Western border of (K 1 W.,) E. of Sharon, presents a grooved or ribbed surface, caused by alternate more and less decomposable layers or strata.

It has been already observed that the unstratified loose materials, accumulated on the surface, are sometimes derived from the decomposition of the rocks in place. It is not always easy to distinguish the transported materials, from those formed, in this manner, on the spot; but a careful examination of the different local formations will, in most instances, enable one to do so with a good degree of certainty. This distinction is of more particular importance in reference to the subject of soils, for frequently the soil, derived from the decomposition of the rocks in place, is essentially different, in character, from that formed by the diluvium, in the immediate vicinity. A striking instance of this occurs in the Micaceous ferruginous formation (E 2 E.,) in the vicinity of Colchester. The surface is there generally covered by a light gravelly diluvial soil, apparently derived from the formations farther West, while at a greater or less depth, beneath the surface, is a fine ferruginous red or yellow earth, formed from the decomposition of the peculiar micaceous rock of the formation. This is exposed in excavations, and is usually more or less apparent on the Eastern slopes of the ridges, while on the opposite declivity, it is concealed by the transported diluvium. The surface of the Micaceous ferruginous formation (D E.) is, to a large extent, covered by a similar ferruginous soil, apparently derived from the decomposition of its own rocks, some of which are occasionally found disintegrated to a great depth, though still re-

taining their peculiar stratified structure. The thin gray micaceous gneiss of the formation (E 1 E.,) particularly that of its Eastern branch, is also very decomposable, and has apparently formed the surface earth, throughout a great part of its extent; the latter consisting of a light grey, rather sandy loam, usually full of small flat fragments of the rock from which it has been derived, particularly observed in excavations. The bowlders scattered on the surface, in this formation, generally consist of the granite and granitic gneiss, forming beds in the micaceous gneiss. That part of the Eastern branch, passing through Lebanon, is, however, covered more or less with bowlders from the Sienitic range (E 3 E.)

A few general remarks may here be offered on the subject of *Soils*. It is not my intention to enter here into any particular detail, but merely by some general observations, to show the important connexion the subject has with the geological system of the State. Soils, in reference to their origin, may be divided into two classes, namely, those formed from the decomposition of the rocks in place, and those derived from transported materials, either diluvium or alluvium. As the character of the latter, particularly the diluvium, depends upon that of the rocks from which they have been derived, all definite knowledge of the soils, so far as their basis is concerned, must depend on an exact knowledge of the different rock formations.

The connexion of different Soils, with particular rock formations, has even attracted general notice. Thus the soil, accompanying the dark sub-porphyritic formations, extending along the Western border of the range (F W.,) particularly those of Greenwich and Wilton (1—4,) has been noted as superior for grain. The rock of those formations, particularly the more Hornblendic varieties, is quite decomposable, forming a dark argillaceous loam, of obvious fertility. The ferruginous soil formed by the decomposition of the rock, in the Micaceous ferruginous formations, particularly that of

(I W,) is apparently peculiarly calculated for the growth of grass. This observation has repeatedly struck me in traversing the latter formation (in Warren, Goshen, and other towns in its range.) That iron in a certain state of oxidation, and perhaps in a certain state of combination with argil, has a fertilizing property, particularly for the grasses, would seem from these facts quite probable. The soil, accompanying the Micaceous formation (E 1 E,) particularly its Eastern branch, is apparently of superior fertility. It consists of a fine light grey loam, of easy tillage, and throughout its extent, through Lebanon, Windham, Hampton, Pomfret, and Woodstock, is accompanied with obvious proofs of agricultural prosperity. On the contrary, the soil of the Granitic formation (A E) is usually dry and meagre, consisting, for the most part, of a gravel formed from the disintegration of its Granitic rocks, though occasionally, as in parts of Stonington and North Stonington, where the rock is peculiarly decomposable, of sufficient fertility. A similar distinction may be made between the soils formed by the decomposition of the Shales and Sandstones of the Secondary formations; those from the former being generally stronger and more fertile than those from the latter. Exceptions may, however, be observed in both instances; the harder and less decomposable shales, as in the interval between the two Eastern posterior ranges of the fourth Eastern Trap system, in Wethersfield, furnishing a less productive soil, than the more argillaceous and at the same time decomposable sandstones, as on the Western border of the Eastern Sandstone range, in Middletown, and in some parts of the Western Sandstone range, particularly where accompanied with beds of a friable shale, as in Cheshire. The soil, derived from the decomposition of amygdaloidal Trap, is usually quite fertile, and is particularly adapted for the growth of fruit trees. The superiority of such a soil may in part be derived from the materials of the amygdaloid itself, particularly its hornblende, and in part from the calcareous spar by which its cavities are sometimes occupied.

Among the examples of Diluvial Soils, may be mentioned those already referred to, on the Western border of the State, formed apparently by materials derived from the argillitic and limestone formations of Dutchess County, and perhaps from others farther West, or from the rocks connected with the limestone valleys of Berkshire and Dover. These soils partake of the fertile character of those connected immediately with those formations, and are obviously superior to those formed from the decomposition of the rocks on which they repose. They are observed, more or less frequently, in the different towns, on the N. W. border of the State, at least as far East as Goshen. The gravelly soils, in Berlin and Newington, within the limits of the Shale of the larger Secondary formation, furnish another instance of diluvial soils, very different from those formed by the decomposition of the rock in place; in this instance, a red clay or loam, derived from the decomposition of the shale, (the proper soil of the district.) These gravelly soils are lighter and naturally less fertile than those derived from the rock in place, but better suited for wet seasons, and capable of great improvement. The Secondary diluvium deposited on the Eastern Primary, West of the Bolton Mica Slate range, may be also referred to, as offering a similar contrast with the soil formed by the Primary rocks of the district.

The alluvial soils of the State correspond with the character of the particular alluvium from which they are formed. Those from the older alluvium are partly sandy or gravelly, and comparatively of little value, though even the lightest are capable of improvement, and partly clayey, forming the the strongest soils in the State, particularly such as occur in the Shale region of the larger Secondary formation. The more recent alluvial soils derive their fertility from the vegetable matter, entering into their composition, but are generally rather light and sandy.

In comparing the different soils in the State, the first place should be given to the river alluvions, connected with the

larger Secondary formation. The soils derived from the Secondary rocks, as a general rule, may be considered preferable to those derived from the Primary rocks; although those derived from the more decomposable Micaceous and Hornblendic rocks in the latter, are sometimes obviously superior to those derived from the less argillaceous sandstones of the former. Among the Primary rocks, the Micaceous and Hornblendic rocks, the Argillites and the Limestones form soils superior to those formed by the Felspathic, the Quartzose, and the Chloritic rocks. In offering these few remarks, I have merely intended to direct attention to the importance of considering soils, in connexion with the different geological formations. It is only from a knowledge of these, that the precise character of the materials, forming the basis of the soils, can be determined. An exact classification of the soils, for practical purposes, would require a particular investigation, which could only be undertaken to advantage after the geological system of the State had been satisfactorily determined.

A few remarks may here be offered on the *Economical* importance of an exact determination of the Geological System of the State. In undertaking the survey, in which I have been engaged, I did not consider its importance as depending on the actual amount of materials, capable of being applied to immediate profit by the State, or by individuals, which might be discovered during its progress. All that I anticipated, in that respect, was to trace, as far as possible, the indications of such materials, and to connect them with the geological system, so as to furnish a guide for future researches. The great object I have had in view, has been to determine as precisely, as time and means would allow, the actual arrangement of the different rocks, occupying the surface of the State. This can furnish the only real basis for any exact researches for useful materials, or in relation to soils, and when once accurately determined, it will remain for the use and advantage of all future

generations. Were this object fully accomplished, I should consider it alone of far more value to the State, than the expenditure already made for this purpose, and the consciousness that I have done something, perhaps not unimportant, towards the determination of the question, will in some degree compensate for the sacrifice of so large a portion of my time, to so little individual advantage.

It is a fact well known, in geology, that different minerals have peculiar associations with different geological formations. This is continually apparent in examining the different formations in this State, particularly those of the Primary class, in which particular minerals form one of the characteristic marks of distinction, much in the same manner as organic remains in the Secondary formations. In those formations, too, the occurrence of particular minerals is not the result of accidental deposition, but of original crystalline or chemical action, and is therefore controlled by specific laws. If then within the limits of any given formation, an important mineral has been profitably explored, and if indications of the same occur more or less frequently throughout the same formation, searches for that mineral may be reasonably made within its limits, and the indications observed may be taken as guides in the examination. On the contrary, the accidental occurrence of diluvial fragments of a mineral, which by the experienced eye, can be satisfactorily traced to its proper formation, within the limits of a formation in which no indications of it have been found in place, will never lead one, acquainted with the subject, to expend time or money in researches for it in such localities. Such researches have been made, at no little expense, by individuals, otherwise intelligent, but who were ignorant of the geological arrangement of the country.

Partial analogies, where the general characteristics of the formations were entirely dissimilar, have led individuals to make expensive researches, in localities where a just knowledge of the subject would have satisfied them that any search for the object in question was entirely hopeless. Thus an

extensive excavation for coal has been recently made at Sandy Hook (Newtown,) in a dark plumbaginous mica slate, breaking in conchoidal fragments, somewhat resembling those of anthracite. The illusion was farther increased by the abundance of pyrites in some parts of the slate, giving it the appearance of combustibility. The frequent occurrence of bitumen and bituminous shale, in the Secondary formations of the State, has led to repeated researches for coal, hitherto without any satisfactory result. As the largest quantities of bitumen have been observed in the Trap rocks, connected with those formations, excavations and even borings for coal have been attempted in that rock, by individuals who were unacquainted with the proper relations of that mineral. The absence of the peculiar distinctive marks of coal, namely, the impressions of ferns, in the bituminous shale, would have led those who understood the value of that indication, at least to have made their researches for that mineral, even in the localities apparently most favorable, with great caution, and in such manner, by extensive association, as to have prevented any serious individual loss.

The minerals of most interest, in an economical point of view, are the more useful metals and coal. Salt and gypsum are of nearly equal interest, but no indications of them have been observed within the limits of the State. Among the ores of iron, the most important in the State, is the Hematite of the N. W. part of Litchfield County. This, as has already been stated in the account of those formations, is chiefly confined to the Mica Slate range (M W.) and the Argillite (O W.,) and is there apparently derived from a peculiar dark plumbaginous variety, both of the mica slate and the argillite. This fact will offer a guide in the search for that valuable ore; the presence of that rock, particularly when accompanied, as it often is, with seams of hematite, furnishing an indication of the probable presence of the ore. The same ore is found in less quantity, and of less value, associated with a peculiar micaceous rock in the formation (H W.,) near its Northern termi-

nation. The character and distribution of that rock has been already detailed in connexion with that formation. The hematite of the Kent ore bed is included in that rock, and is also connected with a pyritiferous Quartz, adjoining the Kent Limestone valley on the East, while traces of the inferior ore of the same species are observed in a similar Quartz rock, in the Eastern part of the Berkshire valley, in North Canaan, and even in a Quartz rock, accompanying the Bolton Mica Slate range (C 3,) in the Eastern Primary. The connexion of magnetic iron with the Granitic formations (K 1—2 W.,) offers another illustration of the relation between important materials and the geological arrangement. Veins of that ore occur in those formations, particularly along their Eastern border, while from their resemblance, in the character of their rocks, to the Granitic range of the Highlands (K 3 W.,) in which that ore is abundant, the presence of valuable deposits of the same ore, within their limits, is rendered at least probable. The ferruginous Micaceous formations (D E.) and (E 2 E.,) and in a less degree, the similar formations (I 1—2 W.,) are peculiar sources of another not unimportant ore of iron, namely, bog ore. The circumstances, under which this ore occurs in those formations, have already been indicated. A knowledge of the extent of those formations will serve to determine the limits, within which probable search may be made for that ore.

The ores of copper, found in the State, have also a similar relation to different geological formations. The copper, connected with the Secondary, is for the most part found either in the Trap, or in the indurated sandstone, adjoining it, and most abundantly in the latter. It is also more particularly connected with the range of West Rock and Mt. Carmel, the posterior Trap range (P. 1 W. S. II,) N. of the latter, and the fourth Eastern main Trap range, from the Hanging Hills Northward. Indications of copper are also observed in the Chloritic formation (A W.) and in the Hornblendic-Chloritic formation (F 3 E.,) extending along the Eastern border of the Norwich range

(F 2 E.) The Bristol copper mine is situated in a Micaceous range, (subordinate to the Mica Slate formation (G N. 1 W.,) and interposed between the Bristol and Canton gneiss basins,) in different parts of which traces of copper have been observed, through an extent of several miles. A Micaceous range, extending along the Western border of the formation (E 4 E.) through South Coventry, Mansfield and Chaplin, is also characterized by traces of copper, particularly in connexion with its granitic beds and veins.

The more probable relations of coal, in the State, have already been indicated, in connexion with the Secondary rocks. The relation of the cement limestone to the band of shale, interposed between the Eastern main Trap range, in the larger Secondary formation, and its appended anterior amygdaloidal range, is here worthy of notice, as also the occurrence of a similar limestone in beds of bituminous or brown shale, in the Middle Shale range, in that formation, usually in the vicinity of the posterior Trap ranges. The limestone in the Western part of the State is too extensively distributed, to need any farther reference. Still it has its peculiar relations to different geological formations, already indicated. The range of detached deposits of white limestone, accompanying the Micaceous formation (E W.,) and its continuation in the Eastern part of the Micaceous formation (G W.,) may be here noticed as illustrating the intimate connexion of a valuable material, with a well marked, though intricately arranged geological formation.

These remarks will serve to show the importance, in an economical point of view, of an exact determination of the geological system of the State. It is unnecessary to enter into farther details on this subject at present, as the connexion of important minerals with the different formations and their subdivisions has been already pointed out in the previous part of the report. I will only here observe that without a precise and definite determination of the different formations, such as I have attempted, any discoveries of new localities of particu-

lar minerals would be of comparatively slight interest or importance, but considered in reference to their place in the geological system, they at once connect themselves with other known localities, in such a manner as to give a comparative certainty to farther investigations.

The *Physical Geography* of the State may be presented under the four distinct heads of Surface, Drainage, Scenery, and Routes of Communication, all of which have an intimate relation to the geological arrangement.

1. The Form of the Surface, in relation to its elevations and depressions, has an obvious connexion with the original geological formation, for although the surface may have been modified somewhat by diluvial and alluvial action, yet its proper outline is apparently such as it had assumed before such action commenced; the diluvium and alluvium having conformed, in a great degree, in their arrangement, to the surface previously existing. Thus the rounded diluvial hills, both in the Primary and Secondary, are generally arranged conformably to the direction of the rock ranges, and are apparently accumulated around ridges of the latter, as nuclei. The valleys, too, although undoubtedly more or less enlarged by denudation, are in like manner distributed conformably to the same arrangement.

All the accounts, I have seen in books, of the form of the surface of the State, are esssentially erroneous, particularly in relation to the mountain ranges, as will be perceived by comparing them with the statement here given. The elevations of the Primary are in every instance entirely distinct from those of the Secondary, and were evidently arranged by a force wholly distinct from that which elevated the latter. The two Secondary formations may be regarded as basins enclosed by the Primary, and including within their limits a series of elevations of Trap and Sandstone, which in every instance are separated from those of the Primary by a distinct valley or depression. The Northern curve in the S. section of the W.

line of Trap, and the Southern curve in the N. section of the same Western range, and a few elevations of Sandstone, immediately adjoin the Primary, but still separated, with very slight exceptions, by an obvious depression. The elevations of the Trap, in the Secondary formations, have already been explained. It, however, may be stated, in general terms, that those of the larger Secondary formation form two extensive main ranges, an Eastern and a Western; the former composed of four subordinate curvilinear ranges, of which the three Southern extend in the same general line, South—North, while the fourth is advanced farther West, nearly in the N.—S. line of East Rock and Mt. Carmel (West line,) with which it is connected, however, only by intervening ridges of sandstone, as already explained. The Western main range presents two distinct sections, separated by an intervening range of sandstone; each composed of two subordinate curvilinear ranges. The most Southern of these includes the remarkable summits of East and West Rock, and Mt. Carmel. The two main ranges are accompanied with inferior lateral ranges, particularly the Eastern, conforming in their arrangement to the main ranges. The elevations of the sandstone, in the same formation, as already stated, conform to those of the Trap ranges. The most remarkable of these are the series of rounded hills, based on shale or sandstone, extending parallel to the third and fourth main curves of the Eastern line of Trap, and the ranges of sandstone, extending along the Eastern border of the formation, posterior to the same curves of the Eastern Trap range. The surface of this formation is generally much lower than that of the adjoining Primary, although its highest elevations exceed those of the latter. A large part of the surface of the formation is occupied by extensive levels or basins, of which the most extensive are those bordering the fourth Eastern main range, on the East and West; namely, the basin of the Connecticut, on the East, and that of Farmington river and the head waters of the Quinipiack, on the West. Another, of large extent, includes the plain at New

Haven, and its two branches, extending along the Quinipiack, on the East, and through Hamden, on the West. These levels or basins are chiefly composed of sandy and gravelly plains. Other smaller basins occur, in the more hilly parts of the formation, all of which have an obvious relation to the arrangement of the Trap system. The most remarkable of these is that of the Mattabesick, in Berlin, inclosed between the fourth Eastern main range and its Western posterior ranges on the West, its Eastern posterior ranges on the N. East, and the N. West part of the third Eastern main range on the S. East. The soil in the lower part of this basin is chiefly a red clay, derived from the adjoining shale. The Western (smaller) Secondary formation also forms a basin, entirely enclosed by the Primary, including, in its more central part, a line of elevations, entirely surrounded by valleys, and composed chiefly of Trap, with lower outworks of sandstone. The highest part of this range is, however, considerably inferior to the average elevation of the surrounding Primary.

The Eastern and Western Primary may both be regarded as extensive plateaus, usually terminating abruptly towards the larger Secondary basin, but sinking more gradually towards the Sound, on the South. These plateaus present, when viewed from an elevated point on their surface, the appearance of a general level, with a rolling or undulating outline, over which the view often extends to a very great distance, interrupted only by isolated summits or ridges, usually of small extent. These plateaus are also intersected by valleys and basins, which serve to mark the arrangement of their surface even more definitely than the elevations. This arrangement will be found to correspond very exactly with that of the geological formations, indicating that it was caused essentially by the original form of the surface of those formations, and not by any subsequent denudation.

The Limestone valleys, near the Western border of the State, are the most extensive and characteristic in the Western Primary. The largest of these, the Dover valley, continued

in that of the Housatonic, in Berkshire (Mass.,) may be considered as dividing the Western Primary into two distinct elevations, which, however, unite, towards the South, in the interval between the Southern extremity of that valley and the Hudson. That part of the Western Primary, East of that valley, forms, within the limits of this State, a wide plateau, such as has been described, generally very abrupt, both West and East, towards that valley and the larger Secondary basin, and of so uniform an elevation, that from many points, little elevated above its surface, the view extends across its entire width, and to a great distance North and South, presenting throughout its whole extent no extensive range of mountains, but only a series of more or less detached and isolated elevations. The most extensive view, observed by me, is from the summit of Ivy Mountain, in Goshen, a short ridge, but little elevated above the general level of the plateau. From that point, the view extends, on the East, over the larger Secondary basin, commanding nearly the whole extent of its Eastern main Trap range, to the range of Bolton Mountain (C 3,) and the Haddam Hills (B,) in the Eastern Primary, and on the W. to the Catskill Mountains, while in a N.—S. direction, it extends from some of the hills near the Sound, to Saddle Mountain, in the N. part of Berkshire County. That part of the Western Primary, West of the Dover valley, forms a comparatively narrow mountain range, that of Taconic Mountain, continued in the low ridge of Mica Slate (M,) dividing that valley from the Northeast Limestone valley (N,) and farther S. connecting itself with the Argillitic range (O,) and the N. E. point of the Granitic range of the Highlands (K 3.) This last, S. of the termination of the Dover valley, unites with the general elevation of the Western Primary, on the Western border of the Calciferous range (H.) The next most remarkable Limestone valley in the Western Primary, is that extending along the Eastern border of the range (H,) with a few interruptions, from New Preston, on the N. E., to North Greenwich, on the S. W. The Limestone valley of Kent, extending from the

S. W. part of Cornwall, along the course of the Housatonic, to Gaylord's Bridge (New Milford,) and thence in the same direction, through Sherman, to the Neversink basin, already alluded to, is the next in importance. This valley is connected with that of Dover, by a transverse valley, isolating the South point of the Granitic formation (K 1,) and giving it the character of a detached mountain range, terminating on the South in Schaghticoke Mountain.

The most remarkable elevations on the surface of the Eastern section of the Western Primary, are that of Ivy Mountain, already noticed, near the centre of (I 1;) Mohawk Mountain, part of a range extending along the Western border of the same formation between Goshen and Cornwall; the Haycock, the highest point of a detached group of rounded summits, on the West border of (K 2,) N. W. of Norfolk village; Prospect Mountain, West of Litchfield, at the N. W. point of the Porphyritic formation (G S. 3 ζ;) and Mt. Tom, not far S. of the latter, a narrow isolated ridge, on the Western border of the Mica Slate formation (G S. 3.) Many rounded detached hills, and occasionally more extended ridges, occur of nearly equal elevation, but which, in the general view, appear only as parts of a common undulating surface. A series of such smooth rounded summits extends nearly parallel to the coast, at no great distance, from Tashua Hill (Trumbull,) on the East, to Round Hill (North Greenwich,) on the West; selected as signal stations for the coast survey. Several more extended rocky ridges occur, closely connected with different geological formations, but generally of inferior elevation to the rounded summits, just noticed, and deriving their mountain character from their isolation by valleys. The ridge (t,) S. W. of Danbury, between the Eastern limestone valley of (H,) and the valley of Mill Plain; that of Shelt Rock, crossing the limestone valley, last noticed, obliquely, E. of Danbury; and the range of the Mica Slate formation (E,) adjoining the Naugatuck, including Beacon Mountain, are of this character. Canaan Mountain is only a promontory of the Mica-

ceous formation (I 1,) projecting N. W. into the S. part of the Berkshire Limestone valley.

The Eastern Primary, viewed from its more elevated points, presents the same general appearance, as the Western; that of an extensive undulating surface of nearly uniform elevation, diversified by detached summits, and in only one instance, marked by an extended mountain range, that of the Bolton Mica Slate range (C 3.) The Lyme Mountain Range, generally represented as traversing the Eastern Primary, from South to North, has clearly no existence. The uniform elevation of the general surface of the Eastern Primary is evident from the fact, that from the summit of Snow Hill (a smooth rounded eminence in the N. W. corner of Ashford,) the view extends from Monadnock and Wachusett Mountains, on the North, to Lantern Hill and the East Haddam Hills, on the South, and from Bald Mountain, on the immediate Western border of the Eastern Primary, to the Western frontier range of the Granitic formation (A,) near the line of Rhode Island. The elevations and depressions of the Eastern Primary have as striking a connexion with the geological formations, as those of the Western Primary. Among the most remarkable elevations, the following may be enumerated. The Bolton Mica Slate range (C 3,) forming the longest continuous mountain range, connected with the Primary, in the State, commences in an abrupt point, at Great Hill (N. of Middle Haddam,) and extends N. at least to the valley of the Chickapee (Mass.) This range is bordered throughout by a well marked valley or depression, on the East, in the line of the Granitic range (C 4.) On the West, detached rounded summits, in the Granitic range (C 2,) are, in some points, of nearly equal elevation, particularly W. of Dark Hollow, and near the N. line of the State. Along the Western border of the Eastern Primary, from Vernon Northward, extends a range of more or less detached summits, including Durfee's Mountain, and Bald Mountain, East of Somers, which within the limits of Massachusetts, forms a more continuous mountain ridge, extending

through Wilbraham, at least to the Chickapee. The Mica Slate range (E 6) forms, in its Southern part, a long narrow ridge similar to that of the Bolton range. The Sienitic formation (E 3,) in Lebanon, forms a detached rocky ridge, not superior in elevation to the general surface of the Eastern Primary, but conspicuous, from its isolated position, and peculiar character. The Sienitic (Chloritic-Hornblendic) formation (F 3,) in Preston and North Stonington, presents a similar isolated group of summits, more or less detached, and from its position at the Southern extremity of the Quinabaug valley, distinctly visible from the N. limits of the State. Lantern Hill, in its vicinity, forms a similar detached elevation.

The most extensive valley, in the Eastern Primary, is that of the Quinabaug, extending South along the course of that river, from its junction with French river, and terminating on the South, in the Griswold basin, already noticed. This is a wider part of a nearly continuous valley, extending along the Western side of the Granitic formation (A) from the Connecticut, in Hadlyme, to Webster, in Massachusetts. This valley is bordered East, by a nearly continuous range, extending along the Western border of (A,) which may be traced from the Connecticut, at Mt. Archer (North Lyme,) to the high ridge, S. of the Middle Boston Turnpike, between East and West Sutton (Mass.) Several isolated basins occur in different parts of the Eastern Primary, as well as of the Western, the most considerable of which extends from the junction of the Willimantic and Mt. Hope rivers in Windham, N. E. along the latter river, into Mansfield.

2. The Drainage, or the arrangement of the Water Courses of the State, has an obvious connexion with the geological arrangement, though in a manner less direct and immediate than the Form of the Surface. The basins of the rivers, in the State, unlike the surface basins, noticed under the preceding head, are rarely limited by a general line of elevation, or confined to a particular depression of the surface; but frequently different rivers rise in the same surface basin, or

even from the same pond or marsh, and flow in different directions across the surrounding lines of elevation, either to different mouths in the sea, or after having performed a large circuit, to a point of junction, thus insulating a large tract of country. Thus the Eastern Limestone valley, in the Western Primary, from Bedford (N. Y.) to New Preston, throughout which extent it presents a slightly interrupted level, is drained to the sea by six streams, namely, the Miannus, Stamford and Norwalk rivers, the Saugatuck and the Housatonic, towards the East, and the Croton, a branch of the Hudson, towards the West; while the Quinabaug interlocks, at its sources, immediately with two sources of the Shetucket (the E. branch of the Willimantic, and Bigelow's river, a branch of Mt. Hope river,) thus insulating a large extent of the Eastern Primary, including probably the highest summit of the latter, within the limits of the State, (Snow Hill, in Ashford.)

The greater part of the surface of the State is drained, in nearly equally proportions, by the waters of the Connecticut, the Housatonic, and the Thames. The arrangement of the basins of these rivers, and the course of the main streams, indicates a system of arrangement in the general surface of the State, apparently independent, at first sight, of the geological arrangement, but when more particularly examined, no less conformable with it, than the arrangement of the surface, considered under the preceding head. By a reference to the accompanying map, where the basins of the rivers are marked by undulating lines, it will be perceived, that the basins of these rivers advance far to the West, towards the North, while on the E. they extend but little farther in that direction than the longitude of their mouths in the sea. The two Western main streams, with the Eastern part of their basins, take a S. Easterly direction, in the Southern part of their course, and thus partly enclose the basin of the main stream next East, on the South, or S. West. The line between the most Eastern and Western points of the two Western basins is thus directed from N. W. to S. E.; in that of the Housatonic, from near the

Western border of the Argillite (O W.,) West of the Dover Limestone valley, to the N. Western border of the Mica Slate formation (C W.) in Woodbridge; in that of the Connecticut, from near the Western border of the Granitic formation (K 2 W.,) between Colebrook and Norfolk, to the Western border of the Granitic formation (A E.) in Salem. That of the Thames extends on the N. W. to the Granitic range (C 2 E.,) near the N. line of the State, thus approaching within a short distance of the larger Secondary formation, there forming the valley of the Connecticut. The basin of the Thames is not limited, on the East, in the same manner as the two Western basins, but extends proportionally farther in that direction, though less than towards the N. West. It occupies a narrow range along the Western border of the Granitic formation (A E.,) from near Lantern Hill Northward; widest in the middle, at Moosup river, but rapidly narrowing towards the North.

The S. E. direction of the two Western main streams (the Housatonic and the Connecticut,) towards their mouths, is apparently caused by the geological arrangement, as already explained. That of the Housatonic, from Kent to Derby, follows nearly the line noticed in the general remarks on the Western Primary, as marking a transverse change in the formations; the Calciferous range (H) and the range (F) lying chiefly on the S. W. of that river, and the Micaceous ferruginous formation (I,) and the Mica Slate formation (G,) on the N. E. The S. E. course of the Connecticut, through the Eastern Primary, from the larger Secondary formation, near Middletown, is, in a similar manner, connected with the geological arrangement; the river first passing nearly in the line separating the two groups or ranges (B) and (C,) then around the N. border of the central plateau of the former (B 1,) then S. near the Western border of (E 1,) while its course farther South is determined by the bend Northward in the Western border of (A.) The arrangement of the basins of these rivers is in the main determined by the course of the

main streams, although a detailed examination would show a satisfactory reason for each particular, in the geological structure of the country.

The distribution of the water courses, in the larger Secondary, is chiefly determined by that of the Trap ridges, particularly the Eastern main range. This from the N. E. point of its second curve (Toket Mountain,) to Cook's Gap (fourth curve,) separates the basin of the Connecticut, on the East, from that of the Quinipiack, on the West; the latter draining the whole of the Secondary, West of the Eastern main range, and S. of a line W. from Cook's Gap, with the exception of the narrow tract drained by Farm river, adjoining the two Southern curves of that range on the West.*

* In tracing the main Eastern line of elevation from the N. point of Middletown Mountain to the S. point of Talcott Mountain, a singular arrangement is observed in the dividing line between the waters of the Quinipiack and the Connecticut. The highest point of the level, in the valleys East and West of the range of Lamentation Mountain, is farther S. than the S. point of that range, the waters of those valleys thus draining Northward to the Connecticut. In the valley West of that range, the waters of the Quinipiack extend farther N. on the East side of the valley, draining to that river the S. part of the interval between that range and its anterior amygdaloidal range; thus corresponding to the arrangement of the sandstone and shale in that valley, already noticed. The valley between the two lines of (E. IV 1 [1]) is about half drained to the South; the basin of the Quinipiack there extending farther N. than in the Western part of the valley last noticed, S. of Beaver Pond. The valley, at Cat Hole, between the West line of ([1]) and South Mountain ([1],) is entirely drained to the South, whilst at the Notch, between ([2]) and ([2],) a stream passes through to the N., draining the interval between the S. front of the main range ([2]) and its anterior amygdaloidal range. At Barnes' Gap, a stream passes through to the N., draining the interval between the N. part of the main range of the Hanging Hills and the anterior amygdaloidal range, whilst at the same time a small basin S. W. of Short Mountain, in the same interval, is drained Westward, across the S. part of the advanced curve in the anterior range, already noticed. From the West front of Short Mountain ([4],) Northward to the S. W. point of the main range of ([6],) the interval between the main and anterior ranges is drained Eastward to the Mattabesick, streams passing through the intervals between ([4]) and ([5],) and ([7]) and ([8],) from basins on the W. side of the main range, at the S. W. higher points of the two divisions of the High Rock range ([5],) respectively. The interval between ([6]) and its anterior range is drained Westward. The most remote source of the Quinipiack drains a large swamp extending along the E. side of the main range N. of Cook's Gap, to a point E. of Farmington Mt. ([8],) passing S. through a depression between the main

3. The Scenery of the State might here be treated as a branch of its Physical Geography, both in its relation to the geological arrangement, and in descriptive picturesque detail. At present, I will only hint at its connexion with the geological arrangement. Each of the geological formations has its peculiar form of surface, more or less distinctive, as well as its peculiar physical character, thus giving rise to different varieties of scenery. Striking illustrations of this are offered by the Trap ridges, the Limestone valleys, some of the Mica Slate ranges, as those of (C—E W.,) and those of (C 3—E 6 E.,) and the Sienitic formations (G S. 3 ζ W.) and (E 3—F 3 E.) The Calciferous formation (H W.) by its abrupt micaceous ridges, alternating with its deep valleys, often containing ranges of limestone, presents some of the most peculiar scenery in the State. A similar remark may be applied to the Dover and Kent Limestone valleys, particularly their branches (Cornwall and Canaan Hollows,) in connexion with the high abrupt ridges and escarpments of the adjoining formations (H—I 1—K 1—M W.) A striking contrast to the picturesque scenery of the formations, last referred to, is offered by the Eastern branch of (E 1 E.,) which presents, throughout the greater part of its course, a series of smooth rounded, but elongated ridges, appearing as regular, in their outline, as works of art.

Western part of (^{7},) and the appended curve at the S. E. point of the latter, and then bending West through the pass of Cook's Gap, between the main ranges (^{6}) and (^{7},) to the plain in the South part of Farmington. The N. East declivity of (^{6}) and the East part of the pass of Cook's Gap are drained to the North branch of the Mattabesick. The interval between the main and anterior ranges from Cook's Gap to the S. point of the anterior range at the N. point of (^{9},) is drained West, that part fronting (^{7}) to the Quinipiack, that farther N. to Farmington river; but the interval between the main and anterior ranges, at the N. point of (^{9},) is drained East to Little river. It thus appears that in the middle higher part of the two Southern divisions of the S. section of (E. IV,) the dividing line extends along the anterior amygdaloidal range, while at their extremities the Trap range is partly drained to the Quinipiack, the sources of that stream extending even to the East side of the main range, at Cat-Hole and Cook's Gap, the S. and N. extremities of that part of the Trap range, apparently intermediate between the third main curve and the proper commencement of the fourth main curve at (^{7}.)

4. The last subject, classed under the head of Physical Geography, namely, Routes of Communication, if treated in detail, would occupy a space incompatible with the extent of this report. It may be remarked, however, that from the intimate connexion of the form of the surface with the geological arrangement, an exact knowledge of the latter would furnish the truest guide in all topographical investigations for such purposes. As an illustration of this remark, I will only state that the route of the New Haven and Hartford Rail Road was pointed out by me; having been determined by me during the progress of a geological exploration of the larger Secondary formation, previous to my engagement in this survey. This route is throughout determined by the geological arrangement of the country, passing in the depression between the Eastern and Western lines of elevation, in the Trap system, to Meriden; then in that between the third and fourth Eastern main ranges to Berlin; then in that between the Eastern and Western sections of the posterior ranges of the fourth main range; and finally entering Hartford around the N. points of the Eastern posterior ranges. The Rainbow route for the Springfield Rail Road, which I also pointed out, is continued along the same general line of depression, a low range extending through the Windsor plain, E. of it, in the line of the Eastern posterior ranges, last noticed.

INDEX.

THE following Index is intended to point out those parts of the preceding report, in which the different formations or their subdivisions, included within the limits of each of the towns in the State, are treated of. As the report is designed to form a connected whole, it should be read throughout in course; still it may he useful to the inhabitants of the different towns, to have the means of referring to those passages which more particularly interest them. The following abbreviations have not been previously introduced:—W.Pr. Western Primary—E.Pr. Eastern Primary—L.S. Larger Secondary Formation—S.S. Smaller Secondary Formation—T.L.S. Trap of the Larger Secondary Formation—T.S.S. Trap of the Smaller Secondary formation—T.D. Trap Dike traversing the Primary—p. the page referred to. All the other abbreviations and characters are explained in the body of the report. Where a formation or subdivision lies only on the border of a town, it is inclosed in parenthesis. Where a formation or subdivision is apparently interrupted in traversing a town, it is inclosed in brackets.

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ERRATA.

Page 39, line 9, for ( ), read (α).

Page 72, line 20, after Trap, add: within the Primary of this State.

Page 461, line 16, (in part of the impression,) for (F 1) read (F 3).